(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 846 965 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
13.03.2002 Bulletin 2002/11

(21) Application number: 96927884.5

(22) Date of filing: 23.08.1996

(51) Int Cl.[7]: G02B 6/24, G02B 6/38

(86) International application number:
PCT/JP96/02357

(87) International publication number:
WO 97/08575 (06.03.1997 Gazette 1997/11)

(54) **OPTICAL FIBER CONNECTOR**

STECKER FÜR OPTISCHE FASERN

CONNECTEUR POUR FIBRES OPTIQUES

(84) Designated Contracting States:
DE FR GB

(30) Priority:
24.08.1995 JP 21637195
21.09.1995 JP 24349195
29.09.1995 JP 25399495
30.11.1995 JP 31324795
14.12.1995 JP 32611095
22.01.1996 JP 876596
22.01.1996 JP 876696
22.01.1996 JP 876796
28.06.1996 JP 17045696

(43) Date of publication of application:
10.06.1998 Bulletin 1998/24

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- PATENT ABSTRACTS OF JAPAN vol. 009, no. 258 (E-350), 16 October 1985 & JP 60 107907 A (NIPPON DENKI KK), 13 June 1985,

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Description

[0001] The present invention relates to an optical fiber connector used in mechanical splices and the like.

[0002] Conventionally, optical fiber connectors have a structure wherein two optical fibers in mutual abutment are affixed inside the same housing.

[0003] Structures for positioning and centering inside such optical fiber connectors include (1) structures wherein the optical fibers are adjoined by inserting them into the ends of a microcapillary, (2) structures wherein the optical fibers are adjoined by laying them in positioning grooves and (3) structures wherein the optical fibers are positioned by being supported in the center of three precision rods or three precision balls. In these optical fiber connectors, a pair of optical fibers is centered and abutted inside a centering device and either adhesively bonded or mechanically wedged into fixation on the centering device.

[0004] In these types of optical fiber connectors, the optical fibers are not freely detachable because the connected optical fibers are adhesively bonded so that their reuse becomes impossible, thus leaving the problem that they cannot be used effectively when changing the connections or the like.

[0005] Additionally, since extremely high precision is required for the work of inserting the optical fibers into the centering devices, the ease of the work decreases. For example, a microscope must be used in order to insert an optical fiber into a microcapillary, causing a lot of trouble in the work. Consequently, the development of an optical fiber connector capable of improving the ease of centering particularly in on-site work has been desired.

[0006] In addition, while structures for guiding the optical fibers to the centering devices through guide grooves or capillaries having low centering precision have been offered, the optical fibers get caught between these guide grooves or capillaries and the centering devices due to the sudden change in the centering precision, thus leaving something to be desired with regard to the ease of the work of inserting optical fibers into the centering devices.

[0007] The present invention has been achieved in consideration of the above-mentioned problems, and has the object of offering an optical fiber connector wherein the ease of the work of centering the optical fiber is improved, and it is possible to change the connections of optical fibers which have already been connected.

[0008] An optical fiber connector in accordance with the invention is defined in claim 1. Examples of suitable springs include C-shaped cross section springs as mentioned below as well as square springs and others. Additionally, the optical fiber used with the optical fiber connector of the present invention may be either glass or plastic.

[0009] Between the base and the lid member of the connector according to the invention, a wedge insertion groove for inserting a wedge from outside is formed so that by pressing a wedge into the wedge insertion groove, the biasing force of the spring is opposed to push apart the base and the lid member. As a result, the element can be opened and closed by means of an insertion and withdrawal operation of the wedge into the wedge insertion groove. When connecting or releasing a connection of optical fibers, the element is opened by inserting the wedge into the wedge insertion groove. As a result, it is possible to switch connections with the optical fiber connector.

[0010] While the number of wedges and direction of insertion of wedges used for opening apart the base and lid member may vary, and they may be inserted from both opposing ends, by making the structure such that wedge insertion grooves are formed at a plurality of locations on both sides in the longitudinal direction (the direction along the centering axis of the centering mechanism) of the base and the lid member for example, the element can be partially opened by selecting a wedge insertion groove to insert a wedge, so that during connection switching for example, it becomes possible to perform work such as exchanging only one optical fiber while holding the other optical fiber which is to be connected to that optical fiber in a clamped state. The wedge insertion grooves are preferably provided at appropriate intervals along the same plane, as a result of which the work of moving the wedge when selecting the wedge insertion grooves for insertion of the wedge is simplified.

[0011] If an opening piece which is withdrawn after insertion of the optical fibers into the element is pre-inserted into the wedge insertion groove, the element is held in a open state until the opening piece is withdrawn so as to enable insertion of optical fibers into the element, and by withdrawing the opening piece from the wedge insertion groove after completion of the work of adjoining and connecting the optical fibers, the element is closed so as to hold the optical fibers in a state of adjoinment. This opening piece is suitable for use during shipping of the optical fiber connector or the like.

[0012] When an engaging projection and an engaging recess are provided at the opposing faces of the base and lid member for positioning them relative to each other in their planar direction, at positions which oppose the wedge insertion groove with respect to the centering axis of the centering mechanism, the relative positional misalignment between the base and the lid member which accompanies the operation of opening and closing the element is prevented by engagement between the engaging projection and the engaging recess, so that a desired centering position of the optical fiber due to the centering mechanism is maintained. The engaging projection and the engaging recess are positioned so as to oppose the wedge insertion grooves, so that interference with insertion and withdrawal of the wedges at the wedge insertion grooves is avoided. Additionally,

for example, if a structure wherein the engaging projection and the engaging recess engage with relative rotation possible centered on the axis of the centering axis is employed, then the engaging projection and the engaging recess act as a hinge so as to allow relative rotation of the base and lid member by insertion and withdrawal of the wedges into the wedge insertion groove, thus making the operation of opening and closing the element smooth.

[0013] Additionally, the present invention may have a structure wherein the lid member is composed of a central lid positioned in correspondence to the centering mechanism and a pair of end lids positioned on both sides of the central lid along the direction of the centering axis of the centering mechanism. According to this structure, by changing the material, shape or molding precision of the central lid and the end lids, it is possible to respond efficiently to clamping of each portion of the optical fiber, thus enabling the optical fiber to be clamped and held more stably. That is, while a high level of molding precision is required for the central lid, a clamping force on the optical fiber is required for the end lids, so that by changing the material, shape or molding precision between the central lid and the end lids, it is possible to flexibly meet these requirements. For example, a structure wherein the central lid and end lids are separate such that the optical fiber cores are held so as to clamp the naked fibers exposed at the tips of the optical fiber cores between the base and the central lid in the vicinity of the centering mechanism, and clamp the covered portions of the optical fiber cores between the base and the end lids at other portions simplifies clamping which is responsive to differences of diameter and the like between the naked fibers and the covered portions, as well as allowing the clamped state of the naked fibers to be held stable due to influences such as vibrations and shocks not being transmitted to the central lid, as opposed to the end lids which are positioned to the outsides of the optical fiber connector and therefore easily receive such influences. Additionally, it is easy to increase the centering precision of optical fibers clamped by the central lid without any dependence on the centering precision of optical fibers clamped by the end lids, so that it is possible to obtain a high centering precision in the vicinity of the centering mechanism, as a result of which a desired connection loss can be stably obtained.

[0014] The present invention may have a composition wherein the element is formed from materials which are transparent or have translucence (semi-transparent). By employing these, the state of insertion of the optical fibers inside the element can be confirmed from outside the element. Additionally, when adjoining the optical fibers for connection, any light leaking from the position of adjoinment which is radiated when there is a large misalignment between the adjoined optical fibers can be viewed from outside the element, thereby allowing the state of connection of the optical fibers to be confirmed from outside the element.

[0015] As to the spring the present invention can also have a structure wherein the element is inserted inside a C-shaped spring having a tubular shape with a C-shaped cross section, with a pressing force on the base and the lid member being applied by the C-shaped spring. The element is inserted with the wedge insertion grooves aligned with the opening portion on the side surface of the C-shaped spring, so that the element can be opened and closed by operation of the wedge from outside the C-shaped spring. Additionally, when the wedge is inserted or withdrawn from the wedge insertion grooves, the C-shaped spring, the base, and the lid member are opened and closed by unitarily rotating centered about the far side of the C-shaped spring opposing the opening portion. When an element using a lid member composed of the three parts of a central lid and end lids is inserted inside the C-shaped spring, the central lid is positioned in the central portion along the longitudinal direction of the C-shaped spring, and the end lids are positioned at the end portions in the longitudinal direction of the same, so that the tips of the optical fibers inserted into the element from both end portions in the longitudinal direction of the C-shaped spring are adjoined into connection between the central lid and the base. The element should preferably have an elliptical, square or hexagonal cross sectional shape, by means of which the biasing force of the C-shaped spring can be applied in concentration on the optical fibers held in the element.

[0016] The present invention may also have a structure wherein a tool engaging surface for restricting axial rotation of the element by engaging with a tool is formed on the side surface of the element exposed in a state of protrusion from the end portions in the longitudinal direction of the C-shaped spring, which enables the ease of insertion and withdrawal of the wedge into the wedge insertion grooves to be increased by holding the element by engaging the tool engaging surface with a tool. Additionally, by providing a rotation restricting projection and a rotation restricting recess on the C-shaped spring and the element for mutually engaging to restrict their relative axial rotation of the C-shaped spring and the element, the wedge insertion grooves can be positioned and fixed at the opening portion of the C-shaped spring so that positional misalignment can be restricted, and positional misalignment does not occur even when the element is opened and closed. Additionally, the C-shaped spring is divided by division slits which are formed at a plurality of locations along the longitudinal direction, and by each portion functioning as a spring for applying pressure separately to the central lid and the end lids, clamping and holding suited to each portion of the optical fiber is possible, while also enabling clamping and clamp release of the optical fiber to be performed separately between the central lid and the end lids, thereby increasing the ease of switching connections and the like.

[0017] If a structure is employed wherein the center-

ing mechanism is a centering groove composed of a V groove or a U groove, or a microcapillary, the centering mechanism is able to be made extremely small, so that the optical fiber connector itself can also be made more compact.

[0018] When a structure wherein optical fiber guide grooves for guiding the optical fibers to the centering mechanism is formed in the base, a guide recess for exposing each optical fiber guide groove is formed in the lid member, and the optical fibers can be inserted into the centering groove by passing from the guide recesses through the optical fiber guide grooves is employed, it is possible to easily insert the optical fibers into the desired optical fiber guide groove by inclining the optical fibers and aligning their tips with respect to the optical fiber guide grooves exposed at the guide recesses.

[0019] Additionally, when a structure comprising optical fiber guide grooves formed with a lower centering precision than the centering mechanism, and a centering guide portion provided between the centering mechanism and an optical fiber guide grooves for guiding the optical fibers guided from the optical fiber guide grooves to the centering mechanism, wherein said centering guide portion is formed into a tapered shape such that the centering precision increases in approaching the centering mechanism side is employed, the optical fibers inserted into the optical fiber guide grooves from the end portions in the longitudinal direction of the element can be inserted into the centering mechanisms simply by pushing them in the direction of the centering mechanisms.

[0020] Hereinbelow, a case of a structure wherein the centering mechanisms are centering grooves formed in one or both of the opposing faces of the base and the lid member is employed shall be explained.

[0021] The centering grooves are shaped to a depth such that the optical fibers protrude from the opposing face by at least 20 microns, such that a clearance is formed between the base and the lid member when the optical fibers housed in the centering grooves are clamped. When this structure is employed, the pressing force between the base and the lid member acts concentrated on the optical fiber, so that the optical fibers can be positioned and centered reliably and with high precision. When one optical fiber is to be clamped, the pressing force between the base and the lid member is concentrated on that optical fiber, and relative rotation between the base and the lid member centered about the optical fiber is permitted, so that the pressing force is reliably applied.

[0022] The centering grooves can be formed on a centering chip built into the element, and when this structure is employed, a high level of processing precision can be obtained by using materials with good processability in this centering chip, thereby enabling the centering precision of the optical fibers to be increased. As examples of materials for the centering chip, it is possible to use zirconia, ceramics, hard synthetic resins, or hard metals. When a centering chip is not employed, the processing precision of the centering grooves can be increased by forming one of the base and the lid member from a hard material, or by forming only the areas of the base or lid member near the centering grooves from hard materials.

[0023] When a plurality of centering grooves which are the centering mechanism are formed on the opposing face on one or both of the base and the lid member, it is possible to have a structure comprising a separation distance maintaining portion which protrudes from at least one or is provided between both of the opposing faces of the base and the lid member, such that the pressure acting between the base and the lid member when the optical fibers housed in the centering grooves are clamped is held uniform by the optical fibers and the separation distance maintaining portion. This separation distance maintaining portion should preferably be provided at a position of the element opposing the wedge insertion grooves with respect to the centering grooves, whereby the pressing force is prevented from being concentrated on the optical fibers in the centering grooves separated from the wedge insertion groove when the element is opened or closed.

[0024] Additionally, the structure may comprise a plurality of centering mechanisms which are provided such that their centering axes are parallel, wherein the optical fiber guide grooves for guiding the optical fibers to the centering mechanisms are provided on one or both of the base and the lid member, and covered portion housing portions are provided between the base and the lid member for housing the covered portions of the optical fibers which are inserted into the centering grooves from the optical fiber guide grooves. When a plurality of centering grooves are provided in parallel, this is suitable for connecting optical fiber tape cores formed from a plurality of naked fibers which are bundled in tape-fashion by means of a covering material. That is, in this type of optical fiber connector, the plurality of single-core naked fibers exposed at the tips of the optical fiber tape cores by removing the covering are respectively held in position by desired centering mechanisms, and the covered portions are housed in covered portion housing portions. When the naked fibers inserted into the optical fiber guide grooves are pushed into their respectively desired centering mechanisms, the covered portions of the optical fiber tape cores are inserted into the element and run over the optical fiber guide grooves to be housed in the covered housing portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Fig. 1 is a drawing showing first embodiment of an optical fiber centering device of the present invention, and is an overall perspective view showing an optical fiber connector.

[0026] Fig. 2 is an exploded perspective view showing

the optical fiber connector of Fig. 1.

[0027] Fig. 3 is a section view along the line A-A of the optical fiber connector of Fig. 1.

[0028] Fig. 4 is a section view along the line B-B of the optical fiber connector of Fig. 1.

[0029] Fig. 5 is a section view along the line B-B showing the state in which the clamping force on the optical fiber core is released by inserting a wedge into the elements of the optical fiber connector of Fig. 1.

[0030] Fig. 6 is a partially enlarged rear view showing the rotation restricting projection and the rotation restricting recess of the present invention.

[0031] Fig. 7 is a perspective view showing an opening piece.

[0032] Fig. 8 is a perspective view showing the opening piece in a state of being withdrawn from the elements.

[0033] Fig. 9 is an enlarged perspective view of an essential part of the centering guide portion.

[0034] Fig. 10 is a section view showing a centering guide portion.

[0035] Fig. 11 is a section view showing a centering chip, in an example wherein the centering chip is provided on the lid member.

[0036] Fig. 12 is a section view showing a centering chip, in an example wherein the centering chip is provided on the base.

[0037] Fig. 13 is an exploded perspective view showing a microcapillary.

[0038] Fig. 14 is a perspective view showing an end portion of the microcapillary of Fig. 13.

[0039] Fig. 15 is an exploded perspective view showing another example of a microcapillary.

[0040] Fig. 16 is an exploded perspective view showing a second embodiment of the optical fiber connector of the present invention.

[0041] Fig. 17 is a section view in the vicinity of the centering grooves of the optical fiber connector in Fig. 16.

[0042] Fig. 18 is a partially enlarged perspective view showing end portions of the optical fiber guide grooves.

[0043] Fig. 19 is a section view showing the guiding concave portion in Fig. 18.

[0044] Fig. 20 is a partially enlarged perspective view showing the details of the guiding concave portion.

[0045] Fig. 21 is a section view of the vicinity of the centering grooves showing the state in which the clamping force on the optical fiber core is released by inserting a wedge into the elements of the optical fiber connector of Fig. 16.

BEST MODE FOR CARRYING OUT THE INVENTION

[0046] Hereinbelow, the present invention shall be explained in further detail with reference to the attached drawings.

[0047] Figs. 1-5 show optical fiber connectors according to a first embodiment of the present invention.

[0048] In the drawings, reference numeral 1 denotes an optical fiber connector according to the present embodiment. As shown in Figs. 1 and 2, this optical fiber connector 1 comprises an element 1A composed of a base 2 and a lid member 3 which have a split structure which forms a roughly elliptical cross-sectional rod shape when united, and a long C-shaped spring 4 which is capable of housing approximately the entirety of the element 1A.

[0049] As shown in Figs. 2 and 4, the base 2 and the lid member 3 are both semi-elliptical rod-shaped members, which are mutually separable at their opposing faces 5, 6. The element 1A is housed inside the C-shaped spring 4 such that the base 2 and the lid member 3 oppose each other on both sides in the direction of action of the biasing force of the C-shaped spring 4. As a result, the major axis of the cross-sectional ellipse is aligned with the direction of action of the biasing force of the C-shaped spring 4, so that the pressing force between the base 2 and the lid member 3 is stabilized. As examples of materials for use in the base 2 of the present embodiment, there are hard synthetic resins such as thermosetting epoxy resins, metals such as aluminum, and ceramics, and examples of materials for use in the lid member 3 include thermosetting epoxy resins or plastics which are softer than the base 2. Additionally, if material which are transparent or translucent are used as the materials for forming the base 2 and the lid member 3, then the state of insertion or state of adjoinment of the optical fibers 7 (single-core optical fibers) can be confirmed by eye.

[0050] The optimum types of optical fiber 7 to use in the optical fiber connector 1 of the present invention are the CCITT standard 125 μm cladding diameter SM (single mode) types or GI (graded index) types. Large diameter optical fibers (including those for purposes other than communications) may also be used. Additionally, when applied to the connection of large-diameter optical fibers, it is of course possible to make various design modifications such as the depths of the centering grooves 8 or optical fiber guide grooves 9, or the clearance maintained between the base 2 and the lid member 3 when clamping the optical fibers.

[0051] As shown in Figs. 2 and 3, a centering groove (V groove) 8 for positioning and centering the optical fibers 7 to enable them to be adjoined and connected is formed in the central portion in the longitudinal direction of the opposing face 5 of the base 2, and optical fiber guide grooves 9 (V grooves) for guiding the optical fibers 7 inserted from outside the base 2 near the centering groove 8 are provided at both ends in the longitudinal direction of the opposing face 5. The centering groove 8 and optical fiber guide grooves 9 are provided colinearly along the longitudinal direction of the base 2. As the centering groove 8 and the optical fiber guide grooves 9, it is also possible to employ U grooves aside from V grooves.

[0052] Naked fibers 7a which are exposed by remov-

ing the coverings at the tips of the optical fibers 7 are housed in the centering groove 8, and the covered portions of the optical fibers 7 are housed in the optical fiber guide grooves 9. As shown in Fig. 4, the centering groove 8 precisely centers the naked fibers 7a when the naked fibers 7a exposed from the optical fibers 7 are housed therein, and is formed so that the naked fibers 7a protrude by t_1 = 30 μm from the opposing face 5.

[0053] As shown in Fig. 2, at three locations along the longitudinal direction of the opposing face 5 of the base, engaging projections 15 which engage with engaging recesses 14 formed in the opposing face 6 of the lid member are formed, and engaging recesses 14 which engage with engaging projections 15 which protrude from the opposing face 6 of the lid member are formed. Curved surfaces 16 which allow relative rotation with respect to the engaging recesses 14 are formed on the tips of the engaging projections 15. As shown in Figs. 4 and 5, the axes of relative rotation of all of the groups of engaging recesses 14 and engaging projections 15 which are engaged when the base 2 and the lid member 3 are united are positioned colinearly along one side in the radial direction of the element 1A (the direction of arrow C in Fig. 2 and left-right in Figs. 4 and 5. Relative rotation between the base 2 and the lid member 3 is possible with this line as the axis. The axis of relative rotation between the base 2 and the lid member 3 is parallel to the axis of the optical fiber connector 1, and is positioned at a side portion of the optical fiber connector 1, so that the mutually engaged engaging recesses 14 and engaging projections 15 perform the function of an opening/closing hinge between the base 2 and the lid member 3.

[0054] As shown in Figs. 2 and 3, the lid member 3 is constructed from the three parts of a central lid 17 corresponding to the centering groove 8 of the base 2 and end lids 18 corresponding to the optical fiber guide grooves 9, which are arranged serially. The central lid 17 and the end lids 18 are serially coupled by mutually engaging coupling end portions 19 which project toward the counterpart sides to which they are to be coupled.

[0055] As shown in Fig. 3, optical fiber housing grooves 20 for housing the upper portions (top side in Fig. 3) of the optical fibers 7 housed in the optical fiber guide grooves 9 are formed in both end lids 18.

[0056] While the opposing face 6 of the central lid 17 is flat, it is also possible to form a naked fiber housing groove for housing the upper portions of the naked optical fibers 7a which are housed in the centering groove 8 at a position corresponding to the centering groove 8. Consequently, it is also possible to accept naked fibers 7a of larger diameters. However, even when a naked fiber housing groove is formed in the opposing face 6 of the central lid 17, a clearance is formed between the opposing faces 5, 6 when the naked fiber 7a is clamped.

[0057] Additionally, the opposing face 6 of the central lid 17 needs to have a high degree of flatness in only the portion opposing the centering groove 8, and the other portions may simply be of a flatness such as not to easily contact the opposing face 5 on the base 2 side when the optical fiber 7 is clamped.

[0058] As shown in Figs. 1 and 3, funnel-shaped insertion recesses 21 for inserting the optical fibers 7 into the optical fiber guide grooves 9 are formed on both ends in the longitudinal direction of the element 1A. Additionally, since tool engaging faces 22a are formed in the side surfaces of the exposed portions 22 of the C-shaped spring 4 which are always exposed on the end portions in the longitudinal direction of the element 1A, they are convenient for affixing tools and the like.

[0059] As shown in Figs. 1 and 4, wedge insertion grooves 25 for inserting wedges 24 to open the base 2 and lid member 3 are opened in the other side portion in the radial direction of the element 1A (the side opposite to the engaging recesses 14 and engaging projections 15). The wedge insertion grooves 25 are formed by gouging out the opposing faces 5, 6 of the base 2 and lid member 3 at four locations along the longitudinal direction of the element 1A, and are made so that the base 2 and lid member 3 are pushed apart by pressing in a wedge 24 in opposition to the clamping force of the C-shaped spring 4. The element 1A is inserted into the C-shaped spring 4 such that the wedge insertion grooves 25 are exposed to the open portion 23 of the C-shaped spring 4.

[0060] When wedges 24 are pressed into the wedge insertion grooves 25, the base 2 and the lid member 3 relatively rotate in the direction of expansion of the wedge insertion grooves 25, centered about the axis of rotation formed by the engaging recesses 14 and the engaging projections 15 which are engaged. The wedges 24 are pressed in such that the tip faces 24a which are shaped flatly contact the furthest portions of the wedge insertion grooves 25. Additionally, as shown in Fig. 5, the wedges 24 have a thickness t_2 which corresponds to the target opening width of the wedge insertion grooves 25, so that it is always possible to open the wedge insertion grooves 25 stably and at a constant opening amount simply due to contact with the furthest portions of the wedge insertion grooves by inward pressure.

[0061] The C-shaped spring 4 has a elongate sleeve shape which is slightly shorter than the element 1A, and is composed of materials such as stainless steel or beryllium bronze. In the case of beryllium bronze, they should more preferably be age hardened or coated with fluorine resins or the like after heat treatment after being molded into the desired shape.

[0062] As shown in Figs. 1 and 2, wedge insertion windows 26 are formed in the open portion 23 of the C-shaped spring 4 at a plurality of locations corresponding to the wedge insertion grooves 25 of the element 1A.

[0063] In Fig. 1, reference numeral 10 denotes division slits which divide the C-shaped spring 4 into a total of three portions corresponding to the central lid 17 and the end lids 18. Consequently, the clamping force of the

C-shaped spring 4 acting on the element 1A acts independently on the central lid 17 and end lids 18. Additionally, since the wedge insertion grooves 25 are also formed at positions corresponding to the central lid 17 and end lids 18, the desired portions of the element 1A corresponding to the central lid 17 and end lids 18 can be separately opened and closed by operating with a wedge 24.

[0064] Fig. 6 shows a rotation restricting projection 2a and rotation restricting recess 4a for restricting the mutual rotation of the element 1A and the C-shaped spring 4. In the drawing, the rotation restricting projection 2a is a projection formed in the element 1A, and the rotation restricting recess is a notch formed in the C-shaped spring 4. The wedge insertion groove 25 and wedge insertion window 26 are held in a state of alignment by the engagement of the two, thereby increasing the ease of insertion and withdrawal of the wedge 24.

[0065] The mode may also be such that a rotation restricting projection protruding on the C-shaped spring 4 side is engaged with a rotation restricting recess formed in the element 1A.

[0066] In Figs. 7 and 8, 1b denotes an opening piece. The opening pieces 1B are used primarily during manufacture and shipment of the optical fiber connectors 1, and by inserting the insertion end portions 1C having tip shapes identical to the wedges 24 into the wedge insertion grooves 25, the element 1A is held in an open state. As a result, while the optical fibers 7 can be freely inserted and withdrawn due to the element 1A being held in an open state until the opening piece 1B is withdrawn, when the adjoinment of the optical fibers 7 is completed, the element 1A is closed by withdrawing the opening piece 1B from the element 1A, so that optical fibers 7, 7 are clamped into the element 1A while still in a state of adjoinment.

[0067] Hereinbelow, various applicable modes for working the optical fiber connector 1 of the present embodiment shall be described.

[0068] Figs. 9 and 10 show a centering guide portion 1D. As shown in Fig. 9, the centering guide portion 1D is a gate-shaped projection provided on the boundary between the optical fiber guide groove 9 and the centering groove 8 on the opposing face 5 of the base 2, having a centering hole 1E communicating with the optical fiber guide groove 9 and the centering groove 8. The centering hole 1E is tapered such that the centering precision gradually increases in approaching the centering groove 8 side from the optical fiber guide groove 9 side, and insertion work can be performed smoothly by inserting a naked fiber 7a into the centering groove 8 from the optical fiber guide groove 9 through this centering hole 1E. Additionally, when using this centering guide portion 1D in the optical fiber connector of the present embodiment, a guide portion housing portion IF for housing the centering guide portion 1D is formed in the lid member 3 as shown in Fig. 10. As a result, when the base 2 and lid member 3 are united, the centering guide portion 1D functions to relatively position the two, thereby preventing positional misalignment between the base 2 and the lid member 3 due to the opening/closing movement of the element 1A. Additionally, the centering guide portion 1D prevents the optical fiber 7 from rising from the base 2 when the element 1A is opened, so that the state of housing of the optical fiber 8 is held stable by the centering groove 8 and the optical fiber guide groove 9.

[0069] In Fig. 11, reference numeral 13 denotes a centering chip. As shown in the drawing, the centering chip 13 is composed of a material which is harder than the element 1A and allows for high processing precision, and is built into the central lid 17 by insertion molding. Materials suitable for the centering chip 13 include, for example, zirconia, ceramics, hard synthetic resins and the like. This centering chip 13 is either for forming a flat opposing surface which faces the base 2, or for forming a centering groove (not shown in the drawing) for retaining the optical fiber 7 together with the centering groove 8 on the base 8 side. In either case, a high centering precision can be obtained for the optical fiber 7 which is retained between it and the centering groove 8.

[0070] It is also possible to form a flat opposing face on the central lid 17 by fitting or bonding a centering chip 13 or forming a plating layer on the central lid 17 in latter procedures. If a plating layer is to be formed, it is preferable that a hard layer composed of metals such as chrome or the like be formed on only the parts at which the naked fibers 7a, 7a are in abutment. By so doing the centering precision of the naked fiber 7a is increased by means of the hard layer, and the naked fiber 7a is pressed into a suitable position by the portions of the central lid 17 softer than the hard layer, so that the clamped state of the naked fiber 7a is held stable. Additionally, it is possible to increase the centering precision of the naked fiber 7a by forming a soft plating layer on the centering chip 13. In this case, by forming a plating layer composed of gold, platinum, aluminum or the like at only the positions which avoid the portions at which the naked fibers 7a, 7a are in abutment, it is possible to obtain the effect of holding the clamped state of the naked fiber 7a stable.

[0071] Fig. 12 shows a centering chip 13a built into the base 2 side by means of insertion molding. In the drawing, a centering groove 13b is formed in the centering chip 13a. Since this centering chip 13a is also formed from materials such as zirconia or ceramics which can obtain a high level of processing precision, it can further increase the centering precision of the naked fiber 7a. It is also possible to form a hard portion on the base 2 by forming a plating layer as with the central lid 17.

[0072] When the centering chips 13, 13a are placed on the element 1A, the processing precision required of other parts of the element 1A is relaxed, and it becomes possible to manufacture the element 1A from cheap materials or materials which generate a larger resistance to withdrawal when the covered portions of the optical fibers 7 are clamped.

[0073] Figs. 13 and 14 show a mode wherein a microcapillary 8a is used as the centering device. As shown in the drawings, optical fiber guide grooves 9 communicate with both ends of the microcapillaries 8a, and it is possible to push optical fibers 7 into the microcapillary from the optical fiber guide groove 9 sides. In the present mode, the optical fibers 7 are adjoined inside the microcapillary 8, so that the optical fibers 7 can always be positioned and centered at a desired precision without depending on the state of clamping between the base 2 and the lid member 3. As a result, a desired connection loss can be obtained stably.

[0074] Fig. 15 shows another mode of the microcapillary 8b. As shown in the drawing, the microcapillary 8b has an open portion 8c wherein the side portion in the central portion along the longitudinal direction is cut away, and is built into the base 2 with this open portion 8c facing the lid member 3 side. The pair of naked fibers 7a, 7a inserted from both ends of the microcapillary 8b are adjoined in the area at which the open portion 8c is formed, and by applying a pressing force between the base 2 and the lid member 3, are pressed into the microcapillary 8b by a projection 8d protruding from the central lid 17. As a result, in this mode, when the element 1A is closed, the optical fibers 7, 7 which are adjoined inside the microcapillary 8b are positioned and centered by both the microcapillary 8b and the projection 8d, so that it is possible to obtain a considerably high centering precision.

[0075] Hereinbelow, the operations and effects of the present embodiment shall be explained.

[0076] With the optical fiber connector 1 of the present embodiment, it is possible to precisely center and adjoin optical fibers 7 by loosening the clamping force between the base 2 and the lid 3 by inserting the wedge 24 into the wedge insertion groove 25 (see Fig. 5), then applying a clamping force to the element 1A after inserting the optical fibers 7 from the insertion recesses 21 of the element 1A and adjoining them in the centering groove 8.

[0077] In order to adjoin the optical fibers 7 inside the optical fiber connector 1, the optical fibers 7 are pushed toward the centering groove 8 from the insertion recesses on both sides of the element 1A. As a result, the naked fibers 7a which have been exposed at the tips of the optical fibers 7 are guided into the centering groove 8 through the optical fiber guide grooves 9, and are adjoined inside the centering groove 8.

[0078] In order to clamp the naked fibers 7a which are in adjoinment, the wedge 24 is withdrawn from the wedge insertion groove 25 and the naked fiber 7a is held between the base 2 and the central lid 17. At this time, as shown in Fig. 4, the opposing face 6 of the central lid 17 is brought into contact with only the naked fiber 7a, so as to form a gap corresponding to the width t_1 (= 30 μm) of projection of the naked fiber 7a from the opposing face 5 between the opposing faces 5, 6 of the base 2 and the central lid 17. As a result, the clamping force between the base 2 and the central lid 17 is concentrated on the naked fiber 7a. On the other hand, the base 2 and the end lids 18 are formed such that the opposing faces 5, 6 are pressed together when the covered portion of the optical fiber a7 are clamped.

[0079] The engaging recesses 14 and the engaging projections 15 are formed such that the curved surfaces 16 of the engaging projections 15 do not contact the engaging recesses 14 when the naked fibers 7a are clamped, so that the clamping force is not applied between the base 2 and the lid member 3, and the central lid 17 and end lids 18 are positioned relative to the base 2.

[0080] In this case, the state of engagement between the coupling end portions 19 (see Fig. 3) permits relative movement of the central lid 17 toward the base 2 with respect to the end lids 18. For example, even when the diameter of the covered portions of the optical fibers 7 is large and a gap is formed between the opposing faces 5, 6 of the base 2 and the end lids 18, it is possible to clamp the naked fibers 7a between the base 2 and the central lid 17. The lateral pressure applied by the central part partitioned by means of the division slits 10 of the C-shaped panel 4 always holds the state of clamping of the naked fiber 7a normal without any dependence on the state of clamping of the covered portion of the optical fiber 7.

[0081] As a result, it is possible to reliably apply a clamping force to the entirety of the adjoined naked fibers 7a of the optical fibers 7, and the precisely centered naked fibers 7a are connected, so as to allow a high connection precision to be reliably obtained. Additionally, since the structure is such that the clamping force between the base 2 and the central lid 17 is received by only the naked fibers 7a, even if the base 2 and central lid 17 rotate about the naked fibers 7a and a relative incline exists to some extent between the opposing faces 5, 6, the clamping force acts on the naked fibers 4a in the correct orientation, so as to maintain the centering precision. Additionally, the base 2 and the lid member 3 only need to have molding precision for the centering grooves 8 and the opposing faces 5, 6 at limited parts which contact the naked fibers 7a while the naked fibers 7a are clamped. The other parts of the opposing faces 5, 6 are permitted to have protruding portions within the range of the gap t_1 formed when the naked fibers 7a are clamped, and the molding precision can be relaxed so that the production of the element 1A becomes simpler and the cost of the optical fiber connector 1 is able to be reduced.

[0082] If the wedges 24 are pressed into the wedge insertion grooves 25 again after the naked fibers 7a have been clamped, it is possible to release the clamp on the optical fibers 7 between the base 2 and the lid member 3, so as to allow the connection of the optical fibers 7 to be switched easily. Additionally, by selecting the wedge insertion groove 25 for inserting the wedge 24, it is possible to release the clamp of the optical fiber

of only one side, thereby increasing the ease of connection switching.

[0083] Figs. 16 through 21 show an optical fiber connector according to a second embodiment of the present invention.

[0084] In the drawings, reference numeral 50 denotes an element to be inserted into the C-shaped spring 4, 51 denotes a base, and 52 denotes a lid member.

[0085] In the optical fiber connector of the present embodiment, only the element has been changed with respect to the optical fiber connector of the first embodiment. The components which are identical to those in Figs. 1 through 5 are denoted by the same reference numbers and their explanations are omitted.

[0086] As shown in Fig. 16, the element 50 has a rod shape which is split into two and has a circular cross section, and is composed of a base 51 and a lid member 52 which both have a semi-circular cross section.

[0087] In the central portion in the longitudinal direction of the opposing face 53 opposing the lid member 52 of the base 51, a plurality of centering grooves 55 (V grooves) for positioning and centering a plurality of naked fibers 54 exposed from the ends of optical fiber tape cores (hereinafter referred to as "tape cores") 54 so as to be capable of being adjoined into connection are formed in parallel fashion, and optical fiber guide grooves 56 for guiding the naked fibers 54a to the centering grooves 53 from the outside of the element 50 are formed the ends of each centering groove 55 to the end portions in the longitudinal direction of the base 51. As shown in Fig. 17, when the centering grooves 55 house the naked fibers 54a, the naked fibers 54a protrude t_3 = 25 μm from the opposing face 53.

[0088] As with the engaging recesses 14 and engaging projections 15 of the first embodiment, engaging recesses 59 and engaging projections 60 which form a hinge mechanism for the base 51 and the lid member 52 are formed on the external side of one portion of the base 51 and the lid member 52 in the width direction of the opposing faces 53, 58 (the direction of the arrow D in Fig. 16), and wedge insertion grooves 61 are formed in the other side portion in the width direction. At a position on the external side of one side portion of the opposing face 53 of the base 51 which avoids the engaging recesses 59 and the engaging projections 60, a separation distance maintaining portion 57 protrudes so as to maintain the separation distance between the opposing faces 53, 58. The separation distance maintaining portion 57 is a portion of the base 51 which bulges outward so as to extend as a protruding strip parallel to the centering grooves *55*, and protrudes from the opposing face 53 by approximately 25 μm.

[0089] As the separation distance maintaining portion, it is also possible to use other parts which are placed between the base 51 and lid member 52, such as projections which protrude from only the lid member 52 or projections which protrude from both the base 51 and the lid member 52, as long as they are capable of forming a desired gap t_3 (see Fig. 17) between the opposing faces 53, 58.

[0090] As shown in Fig. 18, the guide end portions 62 which open at both ends in the longitudinal direction of the base 51 of the optical fiber guide grooves 56 are inclined such that the depth from the opposing face 53 increases in approaching the tip of the base 51, so that the tape core 54 can be easily inserted even when the element 50 is united.

[0091] The lid member 52 is a three-part body composed of two end lids 52a and one central lid 52b which correspond to the division slits 10 of the C-shaped spring 4, so that the clamping force of each part of the C-shaped spring 4 divided by the division slits 10 separately acts on each part of the element 50 corresponding to the end lids 52a and central lid 52b.

[0092] As shown in Figs. 16 and 19, guide recesses 52c for guiding the respective naked fibers 54a of the tape core 54 into the optical fiber guide grooves 56 are formed in both ends of the lid member 52 (the end of each end lid 52a). These guide recesses 52c are cut away such as to expose the guide end portions 62 of the optical fiber guide groove 56, and are tapered such that the opening gradually shrinks in approaching the centering groove 55. Moreover, as shown in Fig. 20, since a plurality of guide grooves 63 for guiding the tips of the naked fibers 54a from the guide recesses 52c to the respectively desired optical fiber guide grooves 56 are formed in the end surfaces of the end lids 52a, the naked fibers 54a can be easily inserted into the optical fiber guide grooves 56 simply by aligning the naked fibers 54a with the guide grooves 63 and pushing them into the element 1A.

[0093] As shown in Fig. 19, covered portion housing portions 64 for housing the covered 54b portions of the tape core 54 are formed between the end lids 52a and the base 51. The covered portion housing portions 64 are grooves which are recessed from the opposing faces 53, 58 of the base 51 and the end portions 52a, such that when the element 50 is closed, the covered 54b portions are clamped at the base 51 side on the same line as the centering axes of the naked fibers 54a in the centering grooves 55. The tape core 54 housed inside the covered portion housing portions 64 are clamped between the tips of partitioning walls 62a which partition the optical fiber guide grooves 56 (see Fig. 18) and the opposing face 58 of the end lids 52a. Each optical fiber guide groove 56 is inclined so as to run up from the covered portion housing portion 64 and communicate with a centering groove 55, so that the insertion of the naked fibers 54a from the optical fiber guide grooves 56 to the centering grooves *55* can be performed smoothly.

[0094] The tape cores 54 used in the optical fiber connector of the present embodiment, when adjoined into connection inside the optical fiber connector, are inserted into the centering groves 56 by exposing the naked fibers 54a at the tip portions to the lengths of housing of the centering grooves 55, then inserting them into the

guide end portions 62 such that the naked fibers 54a are lain in the corresponding optical fiber guide grooves 56. When the naked fibers 54a are inserted into the centering grooves for a standard length, the covered 54b portions of the tape cores 54 run up from the optical fiber guide grooves 56 over the partitioning walls 62a and are housed in the covered portion housing portions 64. They can be clamped between the base 51 and the end lids 52a by applying the clamping force of the element 50 in this state.

[0095] While the optical fiber guide grooves 56 are square grooves in Fig. 18, they may be formed as V grooves or U grooves as well.

[0096] Hereinbelow, the operations and effects of the optical fiber connector according to the present embodiment shall be explained.

[0097] In order to adjoin tape cores 54 by using this optical fiber connector, the clamping force acting between the base 51 and the lid member 52 is relaxed by inserting wedges 24 into the wedge insertion grooves 61 (see Fig. 21) and inserting the naked fibers 54a exposed at the tips of the tape cores 54 from the guide end portions 62 at both ends of the element 50 so as to adjoin them inside the centering groove 55, then the wedges 24 are withdrawn to allow the clamping force of the C-shaped spring 4 to act on the element 50 to clamp *the* tape cores 54 between the base 51 and the lid member 52, thereby maintaining a state of adjoinment between the naked fibers 54a.

[0098] As shown in Fig. 17, when the tape cores 54 are clamped, a uniform gap of t_3 (= 25 μm) is maintained between the opposing faces 53, 58 of the base 51 and the central lid 52 by the naked fibers 54a and the separation distance maintaining portions 57, so that the clamping force acts uniformly on each naked fiber 54a and all of the naked fibers 54a are centered with high precision, thereby increasing the connection precision between the tape cores 54. Additionally, when the wedges 24 are withdrawn from the wedge insertion grooves 61, the separation distance maintaining portions 57 first contact the opposing face 58 of the central lid 52b, thereby preventing the clamping force from being concentrated on the naked fibers 54a which are closest to the center of rotation of the base 51 and the lid member 52 and allowing the clamping force to act on all of the naked fibers 54a approximately simultaneously. As a result, the light transmission characteristics of all of the naked fibers 54a can be held stable.

[0099] The optical fiber connector of the present embodiment can also be applied to the connection of a plurality of single-core optical fibers.

[0100] The number of centering grooves 55 formed is not restricted to that shown, so that they can be made more numerous in order to enable application to the connection of optical fibers having more cores.

[0101] With the optical fiber connector of the present invention, it is possible to use centering grooves other than V grooves, e.g. U grooves, and it is possible to use clamping means other than C-shaped springs, e.g. square springs.

[0102] Additionally, as the centering mechanism, it is possible to use structures which hold the optical fibers at the center of three precision rods or three precision balls.

Claims

1. An optical fiber connector for adjoining and connecting optical fibers (7, 54), comprising:

    a base (2,51) and a lid member (3,52) united in a separable manner so as to form an element (1A,50) having a rod-like shape;

    a spring (4) housing and enclosing the base (2,51) and the lid member (3,52) so as to apply pressure to press them together; and

    an aligning mechanism (8, 8a, 8b, 55), provided on at least one of or between opposing faces of the base (2,51) and the lid member (3,52), for positioning and aligning the optical fibers (7,54) to be connected;

    characterized in that at least one wedge insertion groove (25,61) is formed along the element (1A,50) between opposed edges of the base and the lid so that by pressing a wedge (24) into the wedge insertion groove (25,61) in a transverse direction, the spring (4) can be expanded to enable the separation of the base (2,51) and the lid member (3,52).

2. The optical fiber connector as recited in claim 1, wherein a plurality of the wedge insertion grooves (25,61) are formed between the base (2,51) and the lid member (3,52) at a plurality of locations in the longitudinal direction of the element (1A,50).

3. The optical fiber connector as recited in claim 1, further comprising an opening tool (1B) having at least one wedge portion (1C,24) which can be inserted into the wedge insertion groove (25,61) so as to allow the insertion of optical fibers (7,54) into the element (1A,50).

4. The optical fiber connector as recited in claim 1, wherein at least an engaging projection (15) and at least an engaging recess (14) are provided at the opposing faces of the base (2,51) and the lid member (3,52) for positioning them relative to each other, and the engaging projection (15) and the engaging recess (14) are located at positions which oppose the wedge insertion groove (25, 61) with respect to the centering axis of the aligning mecha-

nism (8,55).

5. The optical fiber connector as recited in claim 1, wherein the lid member comprises a center lid (17, 52b) positioned over the aligning mechanism (8, 55), and a pair of end lids (18, 52a) positioned at opposite sides of the central lid (17, 52b) in the centering axis direction of the aligning mechanism (8, 55).

6. The optical fiber connector as recited in claim 1, wherein the element (1A, 50) is composed of a transparent or translucent material.

7. The optical fiber connector as recited in claim 1, wherein the spring is a tubular spring (4) having a C-shaped cross section, and the element (1A, 50) is inserted inside the tubular C-shaped spring.

8. The optical fiber connector as recited in claim 7, wherein at least one end of the element (1A, 50) protrudes from the ends of the C-shaped spring (4) in a longitudinal direction thereof, and the protruding end of the element (1A, 50) has a tool engaging face (22a) on the circumferential surface thereof for engaging with a tool to restrict axial rotation of the element (1A, 50).

9. The optical fiber connector as recited in claim 7, wherein a rotation restricting projection (2a) and a rotation restricting recess (4a) are provided respectively on the C-shaped spring (4) and the element (1A, 50) for mutually engaging so as to restrict relative axial rotation.

10. The optical fiber connector as recited in claim 5, wherein the spring is a tubular spring (4) having a C-shaped cross section, the C-shaped spring comprising a center part and a pair of end parts divided by division slit (10), and the center part and the end parts respectively apply pressure to the central lid (17) and the end lids (18).

11. The optical fiber connector as recited in claim 1, wherein the aligning mechanism is a centering groove (8, 55) having a cross section of V-shape or U-shape, or a microcapillary (8a, 8b).

12. The optical fiber connector as recited in claim 1, wherein at least a pair of optical fiber guide grooves (9, 56) are formed in both ends of the base for guiding the optical fibers into the centering mechanism, and at least a pair of guide recesses (52c) are formed in the circumferential surface of the end of each lid member (3, 52) for exposing both ends of the optical fiber guide groove (9, 56), so as to allow the optical fibers to be inserted from the guide recess along a radial direction into the optical fiber grooves (9, 56).

13. The optical fiber connector as recited in claim 1, wherein at least a pair of optical fiber guide grooves (9) are formed at opposite ends of the base (2) for guiding the optical fibers into the aligning mechanism (8), with a centering guide portion (1D) being interposed between each of the optical fiber guide grooves (9) and the centering mechanism (8), the centering guide portions (1D) having a tapered guiding surface such that the aligning precision increases in approaching the aligning mechanism (8).

14. The optical fiber connector as recited in claim 1, wherein the aligning mechanism is a centering groove (8, 55) formed on one or both of the opposing faces of the base (2, 51) and the lid member (3, 52), the centering groove (8, 55) being formed to a depth such that a received optical fiber protrudes by at least 20 micrometers from the opposing face and a clearance is formed between the base and the lid member when an optical fiber housed in the centering groove is clamped.

15. The optical fiber connector as recited in claim 1, wherein the aligning mechanism is at least one centering groove (8) formed by a V groove or a U groove, and the centering groove (8) is formed in a centering chip (13, 13a) incorporated in a surface of one or both of the base and the lid member.

16. The optical fiber connector as recited in claim 1, wherein the aligning mechanism comprises a plurality of centering grooves (55) formed in one or both of the base and the lid member, a separation distance maintaining portion (57) protruding from at least one opposing face is being provided between both the opposing faces of the base and the lid member, such that the pressure acting between the base and the lid member on optical fibers housed in the centering grooves is uniform.

17. The optical fiber connector as recited in claim 1, wherein the aligning mechanism comprises a plurality of centering grooves formed in the face of one or both of the base and the lid member, with corresponding optical fiber guide grooves for guiding the optical fibers to the centering mechanisms being provided on one or both of the base and the lid member, and together with covered portion housing portions (64) for housing covered portions (54a) of the optical fibers which are inserted into the centering grooves from the optical fiber guide grooves between the base and the lid member.

18. The optical fiber connector as recited in claim 1, wherein at least one end of the element (1A, 50) has a rotation restricting projection (2a), and at least

one end of the spring has a recess (4a) which engages with the rotation restricting projection (2a) to prevent the relative rotation between the element (1A, 50) and the spring (4).

Patentansprüche

1. Optischer Steckverbinder zum Aneinanderfügen und Verbinden von optischen Fasern (7, 54), folgendes umfassend:

   ein Unterteil (2, 51) und ein Oberteil (3, 52), die auf trennbare Weise so verbunden werden, daß sie ein Element (1A, 50) bilden, das eine stangenartige Form aufweist;

   eine Feder (4), die das Unterteil (2, 51) und das Oberteil (3, 52) aufnimmt und so umschließt, daß sie durch deren Druck zusammengepreßt werden; und

   einen Ausrichtungsmechanismus (8, 8a, 8b, 55), der auf mindestens einer der oder zwischen den Gegenflächen des Unterteils (2, 51) und des Oberteils (3, 52) vorgesehen ist, um die zu verbindenden optischen Fasern (7, 54) zu positionieren und auszurichten;

   dadurch gekennzeichnet,
   daß mindestens eine Keileinführungsnut (25, 61) entlang des Elements (1A, 50) zwischen den gegenüberliegenden Kanten des Unterteils und des Oberteils geformt ist, so daß durch Drücken eines Keils (24) in die Keileinführungsnut (25, 61) die Feder (4) gedehnt werden kann, um die Trennung des Unterteils (2, 51) und des Oberteils (3, 52) zu erlauben.

2. Optischer Steckverbinder nach Anspruch 1, wobei an mehreren Stellen in der Längsrichtung des Elements (1A, 50) mehrere Keileinführungsnuten (25, 61) zwischen dem Unterteil (2, 51) und dem Oberteil (3, 52) geformt sind.

3. Optischer Steckverbinder nach Anspruch 1, überdies ein Öffnungswerkzeug (1B) mit mindestens einem Keilteil (1c, 24) umfassend, das in die Keileinführungsnut (25, 61) gesteckt werden kann, um die Einführung von optischen Fasern (7, 54) in das Element (1A, 50) zu erlauben.

4. Optischer Steckverbinder nach Anspruch 1, wobei mindestens ein eingreifender Vorsprung (15) und mindestens eine eingreifende Aussparung (14) an den Gegenflächen des Unterteils (2, 51) und des Oberteils (3, 52) vorgesehen sind, um sie relativ zueinander zu positionieren, wobei der eingreifende Vorsprung (15) und die eingreifende Aussparung (14) an Stellen vorgesehen sind, die der Keileinführungsnut (25, 61) in bezug auf die Zentrierachse des Ausrichtungsmechanismus (8, 55) gegenüberliegen.

5. Optischer Steckverbinder nach Anspruch 1, wobei das Oberteil ein mittleres Oberteil (17, 52b) umfaßt, das über dem Ausrichtungsmechanismus (8, 55) liegt, und zwei Endoberteile (18, 52a), die in Richtung der Zentrierachse des Ausrichtungsmechanismus (8, 55) auf den Gegenseiten des mittleren Oberteils (17, 52b) liegen.

6. Optischer Steckverbinder nach Anspruch 1, wobei das Element (1A, 50) aus einem transparenten oder durchscheinenden Material besteht.

7. Optischer Steckverbinder nach Anspruch 1, wobei die Feder eine rohrförmige Feder (4) mit C-förmigem Querschnitt ist und das Element (1A, 50) in diese rohrförmige C-förmige Feder gesteckt wird.

8. Optischer Steckverbinder nach Anspruch 7, wobei mindestens ein Ende des Elements (1A, 50) aus den Enden der C-förmigen Feder (4) in einer Längsrichtung davon herausragt, und das herausragende Ende des Elements (1A, 50) an seinem Umfang eine Werkzeugansatzfläche (22a) hat, um ein Werkzeug anzusetzen, das die axiale Drehung des Elements (1A, 50) einschränkt.

9. Optischer Steckverbinder nach Anspruch 7, wobei jeweils auf der C-förmigen Feder (4) und dem Element (1A, 50) ein drehungsverhindernder Vorsprung (2a) und eine drehungsverhindernde Aussparung (4a) vorgesehen sind und so ineinander eingreifen, daß die relative axiale Drehung verhindert wird.

10. Optischer Steckverbinder nach Anspruch 5, wobei die Feder eine Feder (4) mit C-förmigem Querschnitt ist, die C-förmige Feder ein Mittelteil und zwei Endteile umfaßt, die durch Teilungsschlitze (10) unterteilt sind, und das Mittelteil und die Endteile jeweils Druck auf das mittlere Oberteil (17) und die Endoberteile (18) ausüben.

11. Optischer Steckverbinder nach Anspruch 1, wobei der Ausrichtungsmechanismus eine Zentriernut (8, 55) mit V-förmigem oder U-förmigen Querschnitt ist, oder eine Mikrokapillare (8a, 8b).

12. Optischer Steckverbinder nach Anspruch 1, wobei mindestens ein Paar Führungsnuten (9, 56) an beiden Enden des Unterteils geformt ist, um die optischen Fasern in den Zentriermechanismus zu führen, und mindestens ein Paar Führungsaussparun-

gen (52c) auf der Umfangsfläche am Ende der Endoberteile (3, 52) geformt ist, um die Führungsnuten (9, 56) an beiden Enden so freizulegen, daß die optischen Fasern von der Führungsaussparung aus entlang einer radialen Richtung in die Führungsnuten (9, 56) geführt werden können.

13. Optischer Steckverbinder nach Anspruch 1, wobei mindestens ein Paar Führungsnuten (9) an den entgegengesetzten Enden des Unterteils (2) geformt sind, um die optischen Fasern in den Zentriermechanismus zu führen, mit einem zentrierenden Führüngsteil (1D), das zwischen jeder Führungsnut (9) und dem Zentriermechanismus (8) liegt, wobei die zentrierenden Führungsteile (1D) eine Führungsfläche haben, die sich so verjüngt, daß die Ausrichtungsgenauigkeit zum Ausrichtungsmechanismus hin zunimmt.

14. Optischer Steckverbinder nach Anspruch 1, wobei der Ausrichtungsmechanismus eine Zentriernut (8, 55) ist, die in einer der oder beiden Gegenflächen des Unterteils (2, 51) und des Oberteils (3, 52) geformt ist, wobei die Zentriernut (8, 55) so tief geformt ist, daß die aufgenommene optische Faser um mindestens 20 Mikrometer aus der Gegenfläche hervorragt und ein Zwischenraum zwischen dem Unterteil und dem Oberteil gebildet wird, wenn die in der Zentriernut aufgenommene optische Faser geklemmt ist.

15. Optischer Steckverbinder nach Anspruch 1, wobei der Ausrichtungsmechanismus mindestens eine Zentriernut (8) ist, die durch eine V-Nut oder U-Nut gebildet wird, und die Zentriernut (8) auf einem Zentrierelement (13, 13a) geformt ist, das in eine Fläche des Unterteils, des Oberteils oder beider integriert ist.

16. Optischer Steckverbinder nach Anspruch 1, wobei der Ausrichtungsmechanismus mehrere Zentriernuten (55) umfaßt, die in der Fläche des Unterteils, des Oberteils oder beider geformt sind, wobei zwischen dem Unterteil und dem Oberteil ein Trennabstandshalter (57) vorgesehen ist, der von mindestens einer Gegenfläche hervorragt, so daß der Druck, der zwischen dem Unterteil und dem Oberteil auf die in der Zentriernut aufgenommenen optischen Fasern wirkt, gleichmäßig ist.

17. Optischer Steckverbinder nach Anspruch 1, wobei der Ausrichtungsmechanismus mehrere Zentriernuten umfaßt, die in der Fläche des Unterteils, des Oberteils oder beider geformt sind, wobei im Unterteil, im Oberteil oder beides entsprechende Führungsnuten vorgesehen sind, um die optischen Fasern zum Zentriermechanismus hin zu führen, zusammen mit Aufnahmeteilen (64) zur Aufnahme des ummantelten Teils (54a) der optischen Fasern, die von den Führungsnuten aus in die Zentriernuten geführt werden.

18. Optischer Steckverbinder nach Anspruch 1, wobei mindestens ein Ende des Elements (1A, 50) einen drehungsverhindernden Vorsprung (2a) aufweist, und mindestens ein Ende der Feder eine drehungsverhindernde Aussparung (4a) aufweist, die in den Vorsprung (2a) eingreift, um die relative Drehung zwischen dem Element (1A, 50) und der Feder (4) zu verhindern.

Revendications

1. Connecteur pour fibres optiques pour assembler et raccorder des fibres optiques (7, 54), comprenant :

    une base (2, 51) et un élément de couvercle (3, 52) unis de manière séparable afin de former un élément (1A, 50) qui a une forme analogue à celle d'une tige,
    un ressort (4) recevant et entourant la base (2, 51) et l'élément de couvercle (3, 52) de manière à appliquer une pression pour les presser ensemble, et
    un mécanisme d'alignement (8, 8a, 8b, 55) disposé sur au moins une des faces opposées de la base (2, 51) et de l'élément de couvercle (3, 52) ou entre celles-ci, pour positionner et aligner les fibres optiques (7, 54) à raccorder,

    caractérisé en ce qu'au moins une rainure d'insertion de cale (25, 61) est formée le long de l'élément (1A, 50) entre des bords opposés de la base et du couvercle de sorte qu'en pressant une cale (24) dans la rainure d'insertion de cale (25, 61) dans une direction transversale, le ressort (4) puisse être détendu pour permettre la séparation de la base (2, 51) et de l'élément de couvercle (3, 52).

2. Connecteur pour fibres optiques selon la revendication 1, dans lequel est formée une pluralité de rainures d'insertion de cales (25, 61) entre la base (2, 51) et l'élément de couvercle (3, 52) à une pluralité d'emplacements dans la direction longitudinale de l'élément (1A, 50).

3. Connecteur pour fibres optiques selon la revendication 1, comprenant en outre un outil d'ouverture (1B) ayant au moins une partie de cale (1C, 24) qui peut être insérée dans la rainure d'insertion de cale (25, 61) de manière à permettre l'insertion de fibres optiques (7, 54) dans l'élément (1A, 50).

4. Connecteur pour fibres optiques selon la revendication 1, dans lequel au moins une saillie d'enga-

gement (15) et au moins un évidement d'engagement (14) sont prévus sur les faces opposées de la base (2, 51) et de l'élément de couvercle (3, 52) pour les positionner l'un par rapport à l'autre, et la saillie d'engagement (15) et l'évidement d'engagement (14) se trouvent à des emplacements qui font face à la rainure d'insertion de cale (25, 61) par rapport à l'axe de centrage du mécanisme d'alignement (8, 55).

5. Connecteur pour fibres optiques selon la revendication 1, dans lequel l'élément de couvercle comprend un couvercle central (17, 52b) positionné sur le mécanisme d'alignement (8, 55) et une paire de couvercles d'extrémité (18, 52a) positionnés sur les côtés opposés du-couvercle central (17, 52b) dans la direction de l'axe de centrage du mécanisme d'alignement (8, 55).

6. Connecteur pour fibres optiques selon la revendication 1, dans lequel l'élément (1A, 50) est composé d'un matériau transparent ou translucide.

7. Connecteur pour fibres optiques selon la revendication 1, dans lequel le ressort est un ressort tubulaire (4) ayant une section transversale en forme de C, et l'élément (1A, 50) est inséré à l'intérieur du ressort tubulaire en forme de C.

8. Connecteur pour fibres optiques selon la revendication 7, dans lequel au moins une extrémité de l'élément (1A, 50) fait saillie des extrémités du ressort en forme de C (4) dans une direction longitudinale, et l'extrémité faisant saillie de l'élément (1A, 50) a une face d'engagement d'outil (22a) sur sa surface périphérique pour venir en prise avec un outil afin de restreindre la rotation axiale de l'élément (1A, 50).

9. Connecteur pour fibres optiques selon la revendication 7, dans lequel une saillie de restriction de rotation (2a) et un évidement de restriction de rotation (4a) sont montés respectivement sur le ressort en forme de C (4) et l'élément (1A, 50) pour venir mutuellement en prise de manière à restreindre la rotation axiale relative.

10. Connecteur pour fibres optiques selon la revendication 5, dans lequel le ressort est un ressort tubulaire (4) ayant une section transversale en forme de C, le ressort en forme de C comprenant une partie centrale et une paire de parties d'extrémité divisées par une fente de division (10), et la partie centrale et les parties d'extrémité, respectivement, appliquent une pression sur le couvercle central (17) et les couvercles d'extrémité (18).

11. Connecteur pour fibres optiques selon la revendication 1, dans lequel le mécanisme d'alignement est une rainure de centrage (8, 55) qui a une section transversale en forme de V ou en forme de U, ou un microcapillaire (8a, 8b).

12. Connecteur pour fibres optiques selon la revendication 1, dans lequel au moins une paire de rainures de guidage de fibres optiques (9, 56) sont formées dans les deux extrémités de la base pour guider les fibres optiques dans le mécanisme de centrage, et au moins une paire d'évidements de guidage (52c) sont formés dans la surface périphérique des extrémités de chaque élément de couvercle (3, 52) pour exposer les deux extrémités de la rainure de guidage de fibres optiques (9, 56) de manière à pouvoir insérer les fibres optiques depuis l'évidement de guidage dans une direction radiale dans les rainures pour fibres optiques (9, 56).

13. Connecteur pour fibres optiques selon la revendication 1, dans lequel au moins une paire de rainures de guidage de fibres optiques (9) sont formées aux extrémités opposées de la base (2) pour guider les fibres optiques dans le mécanisme d'alignement (8), une partie de guidage de centrage (1D) étant intercalée entre chacune des rainures de guidage de fibres optiques (9) et le mécanisme de centrage (8), les parties de guidage de centrage (1D) ayant une surface de guidage effilée de sorte que la précision de l'alignement augmente lorsqu'on s'approche du mécanisme d'alignement (8).

14. Connecteur pour fibres optiques selon la revendication 1, dans lequel le mécanisme d'alignement est une rainure de centrage (8, 55) formée sur une ou sur les deux faces opposées de la base (2, 51) et de l'élément de couvercle (3, 52), la rainure de centrage (8, 55) étant formée sur une profondeur telle qu'une fibre optique reçue fasse saillie d'au moins 20 micromètres de la face opposée et qu'un dégagement soit formé entre la base et l'élément de couvercle lorsqu'une fibre optique logée dans la rainure de centrage est bloquée.

15. Connecteur pour fibres optiques selon la revendication 1, dans lequel le mécanisme d'alignement est au moins une rainure de centrage (8) formée par une rainure en V ou une rainure en U et la rainure de centrage (8) est formée dans une pastille de centrage (13, 13a) incorporée à une surface de l'un et/ou l'autre de la base et de l'élément de couvercle.

16. Connecteur pour fibres optiques selon la revendication 1, dans lequel le mécanisme d'alignement comprend une pluralité de rainures de centrage (55) formées sur l'un et/ou l'autre de la base et de l'élément de couvercle, une partie (57) de maintien

de la distance de séparation faisant saillie d'au moins une face opposée étant ménagée entre les deux faces opposées de la base et de l'élément de couvercle, de sorte que la pression agissant entre la base et l'élément de couvercle sur les fibres optiques logées dans les rainures de centrage soit uniforme.

17. Connecteur pour fibres optiques selon la revendication 1, dans lequel le mécanisme d'alignement comprend une pluralité de rainures de centrage formées sur l'un et/ou l'autre de la base et de l'élément de couvercle, des rainures de guidage de fibres optiques correspondantes pour guider les fibres optiques vers les mécanismes de centrage étant ménagées sur l'un et/ou l'autre de la base et l'élément de couvercle, conjointement avec des parties (64) de logement des parties couvertes pour loger des parties couvertes (54a) des fibres optiques qui sont insérées dans les rainures de centrage à partir des rainures de guidage de fibres optiques entre la base et l'élément de couvercle.

18. Connecteur pour fibres optiques selon la revendication 1, dans lequel au moins une extrémité de l'élément (1A, 50) a une saillie de restriction de rotation (2a) et au moins une extrémité du ressort a un évidement (4a) qui vient en prise avec la saillie de restriction de rotation (2a) pour empêcher la rotation relative entre l'élément (1A, 50) et le ressort (4).

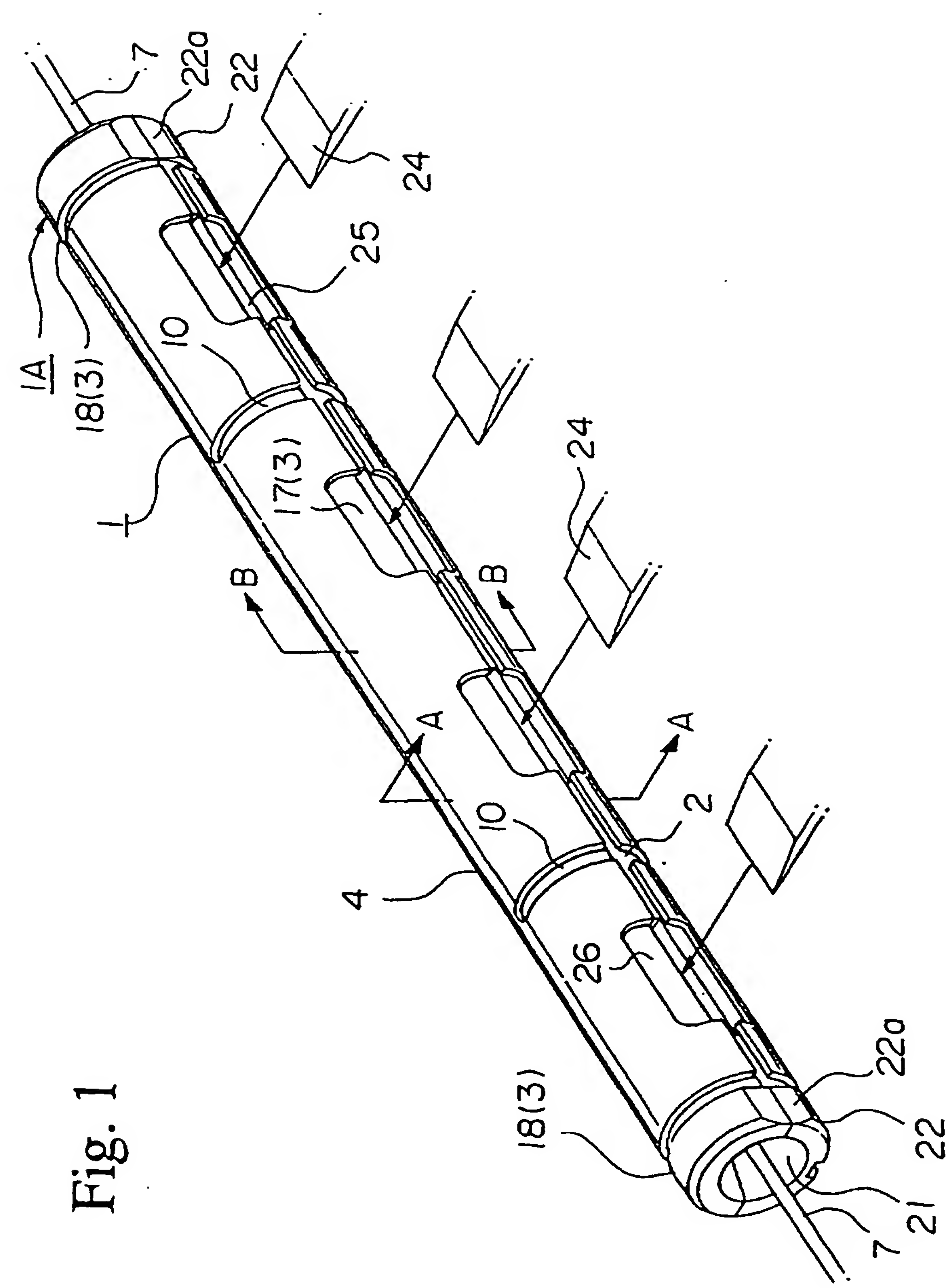


Fig. 1

Fig. 2

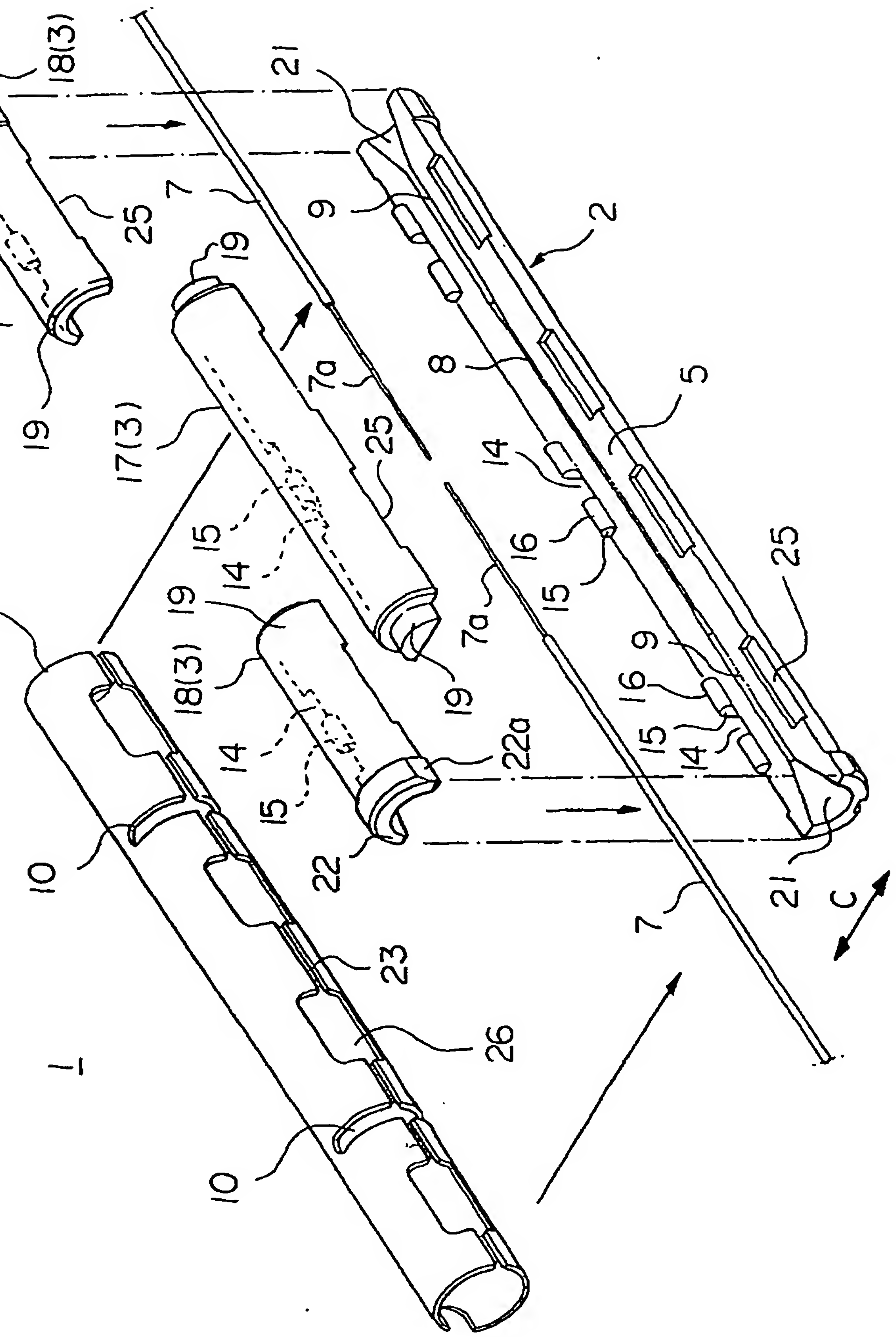


Fig. 3

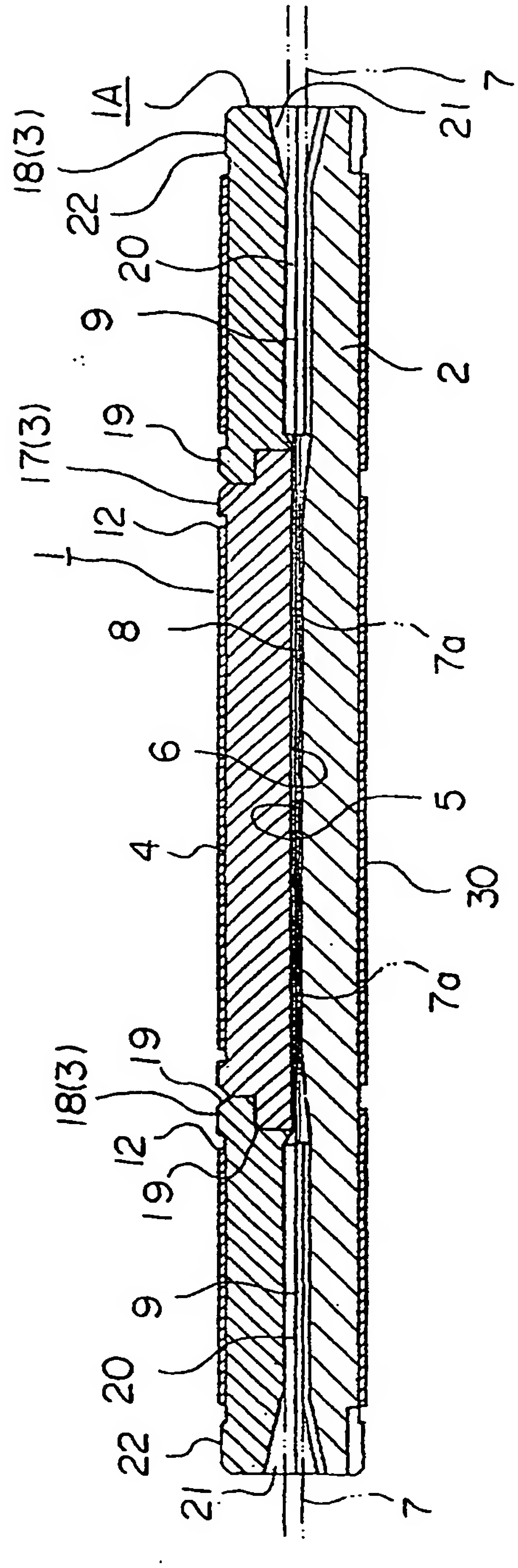


Fig. 4

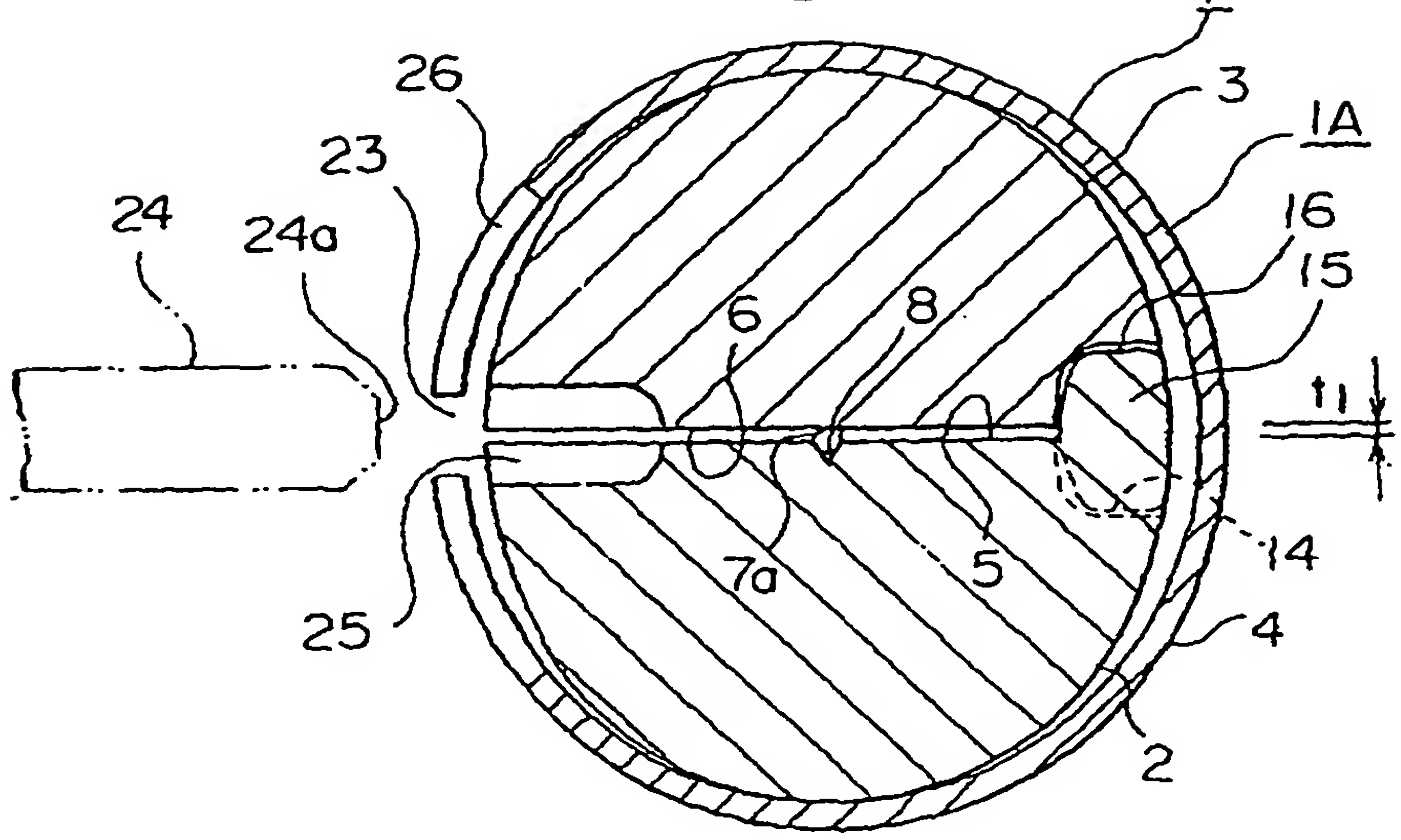
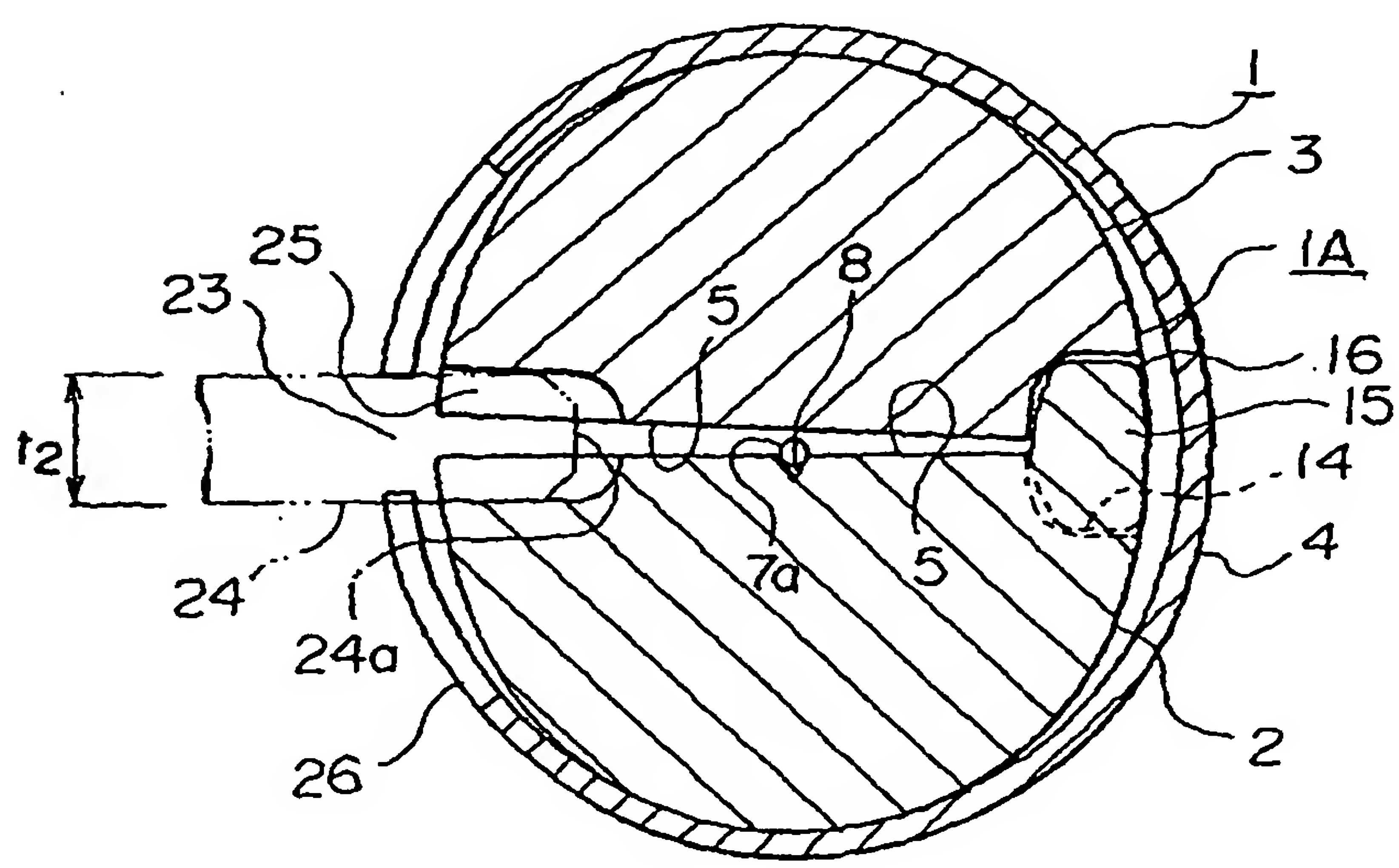

26
23
24
24a
6
8
1
3
1A
16
15
t1
14
5
7a
25
4
2

Fig. 5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t2
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7a
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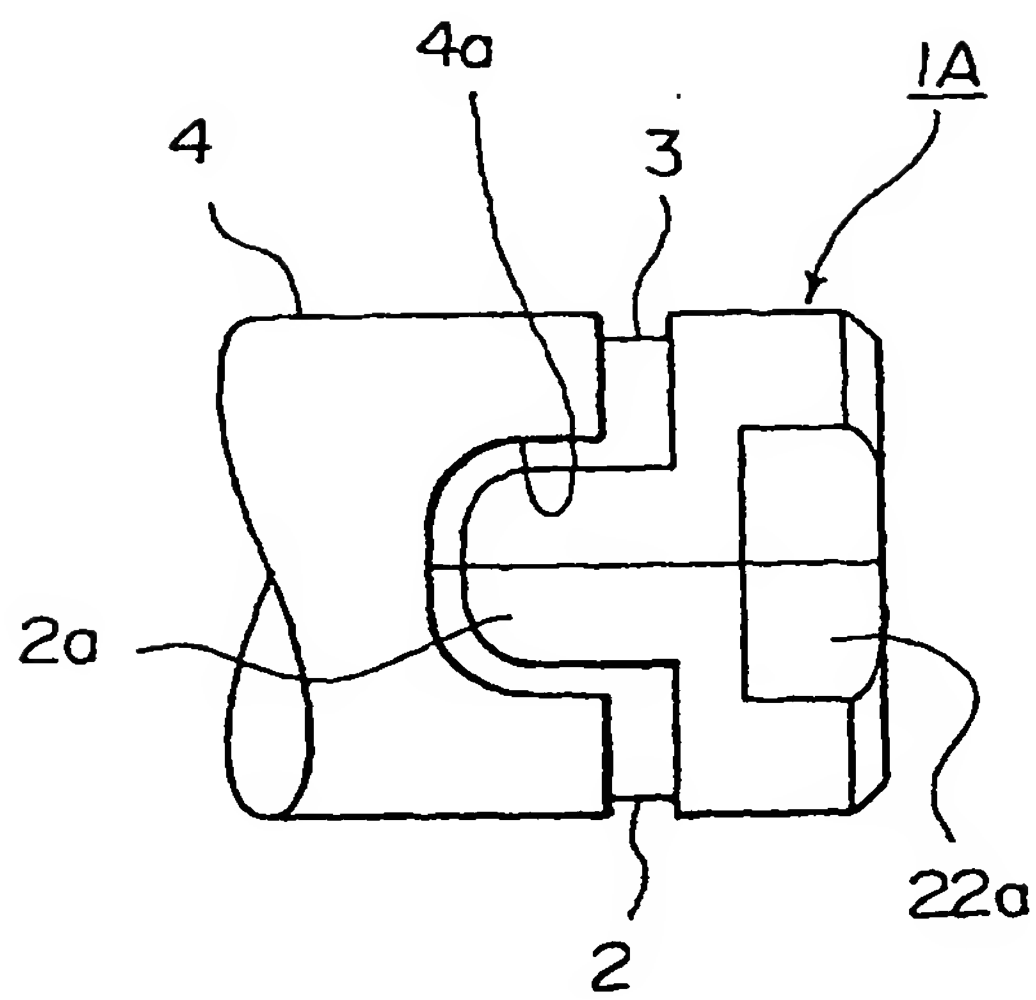
24a
26
2

Fig. 6



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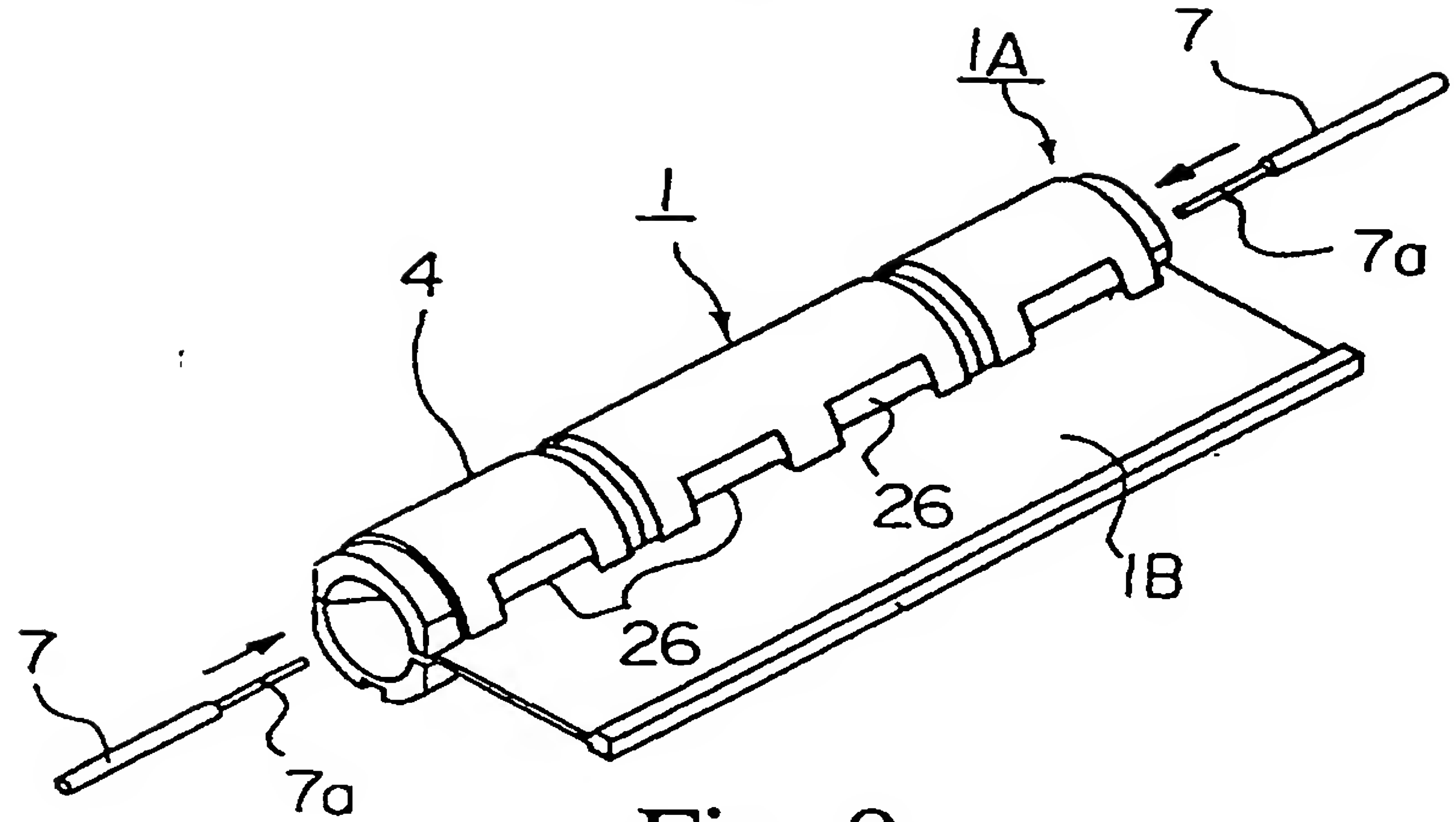


Fig. 8

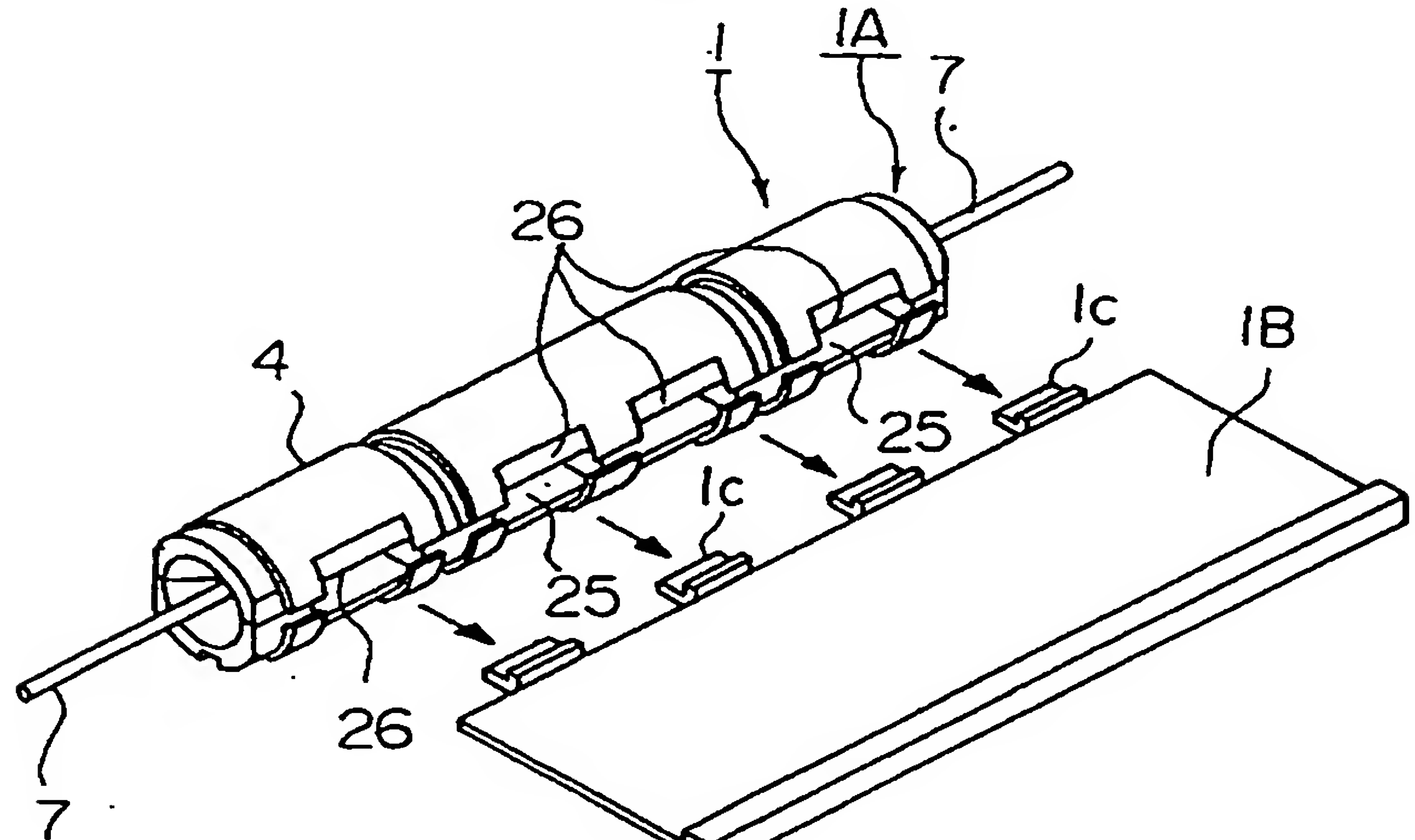
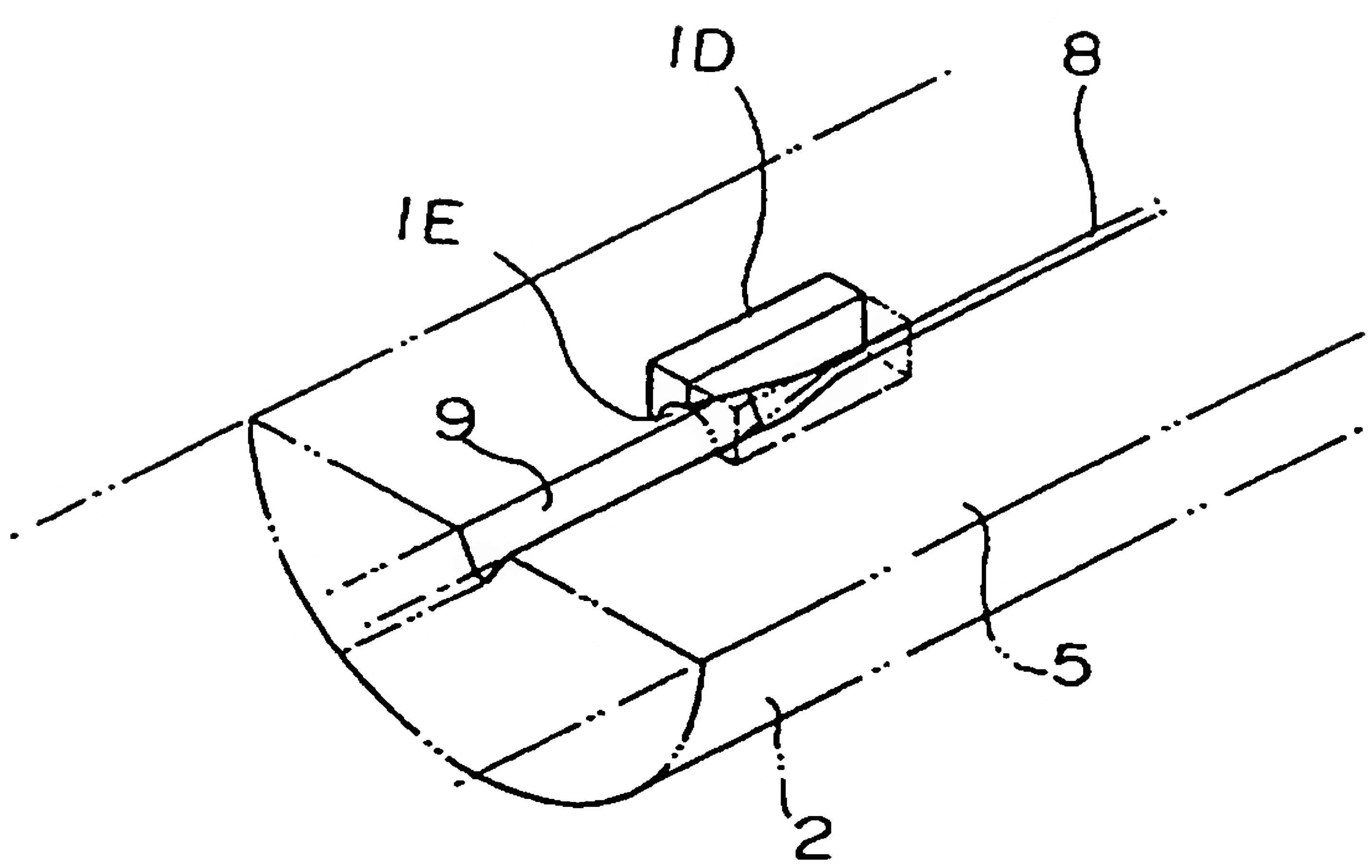


Fig. 9



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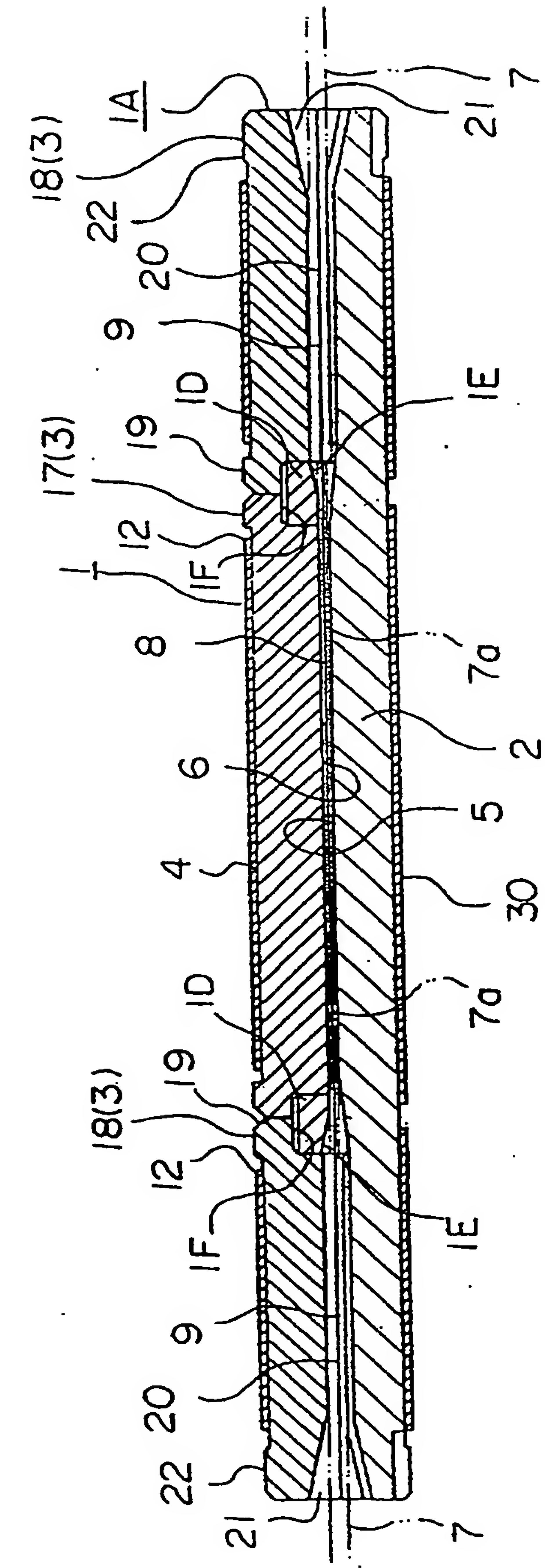
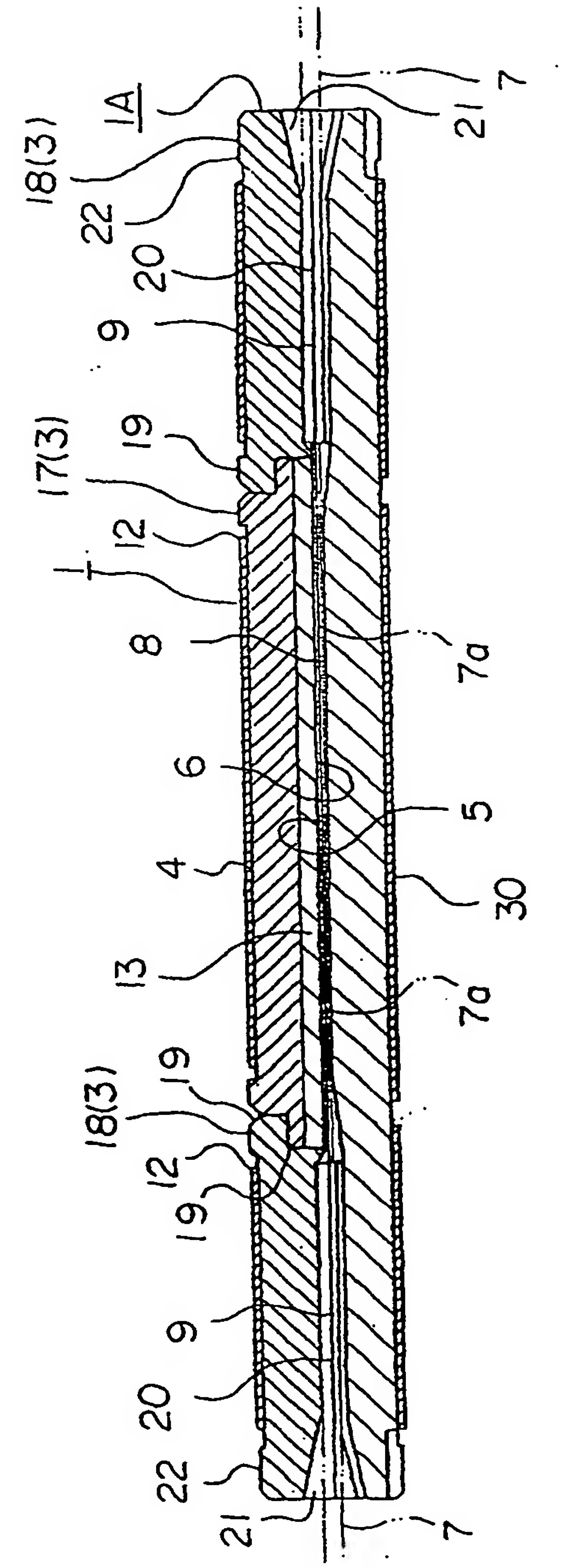

1A
18(3)
22
20
9
1D
19
17(3)
12
1F
1
8
6
4
1D
19
18(3)
12
1F
9
20
22
21
7
21
1E
7a
2
5
30
7a
1E
7

Fig. 11


1A
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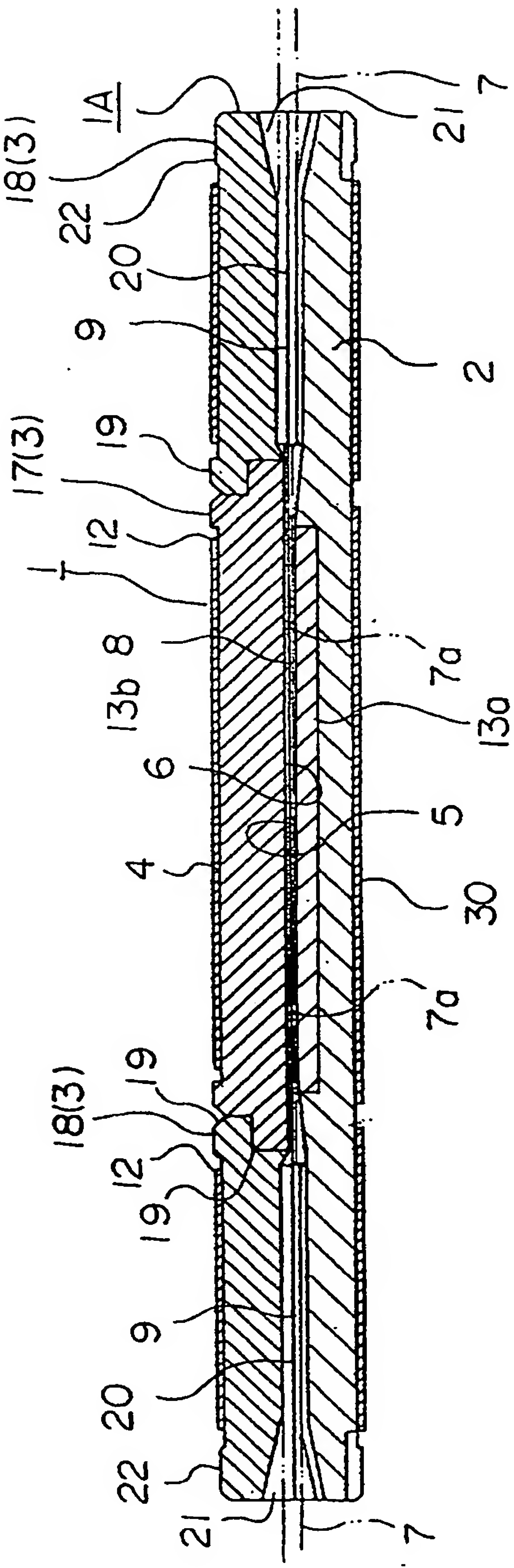
7a
5
30
7a

Fig. 12


1A
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19
12
1
13b
8
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4
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20
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7
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2
7a
13a
5
30
7a
7

Fig. 13

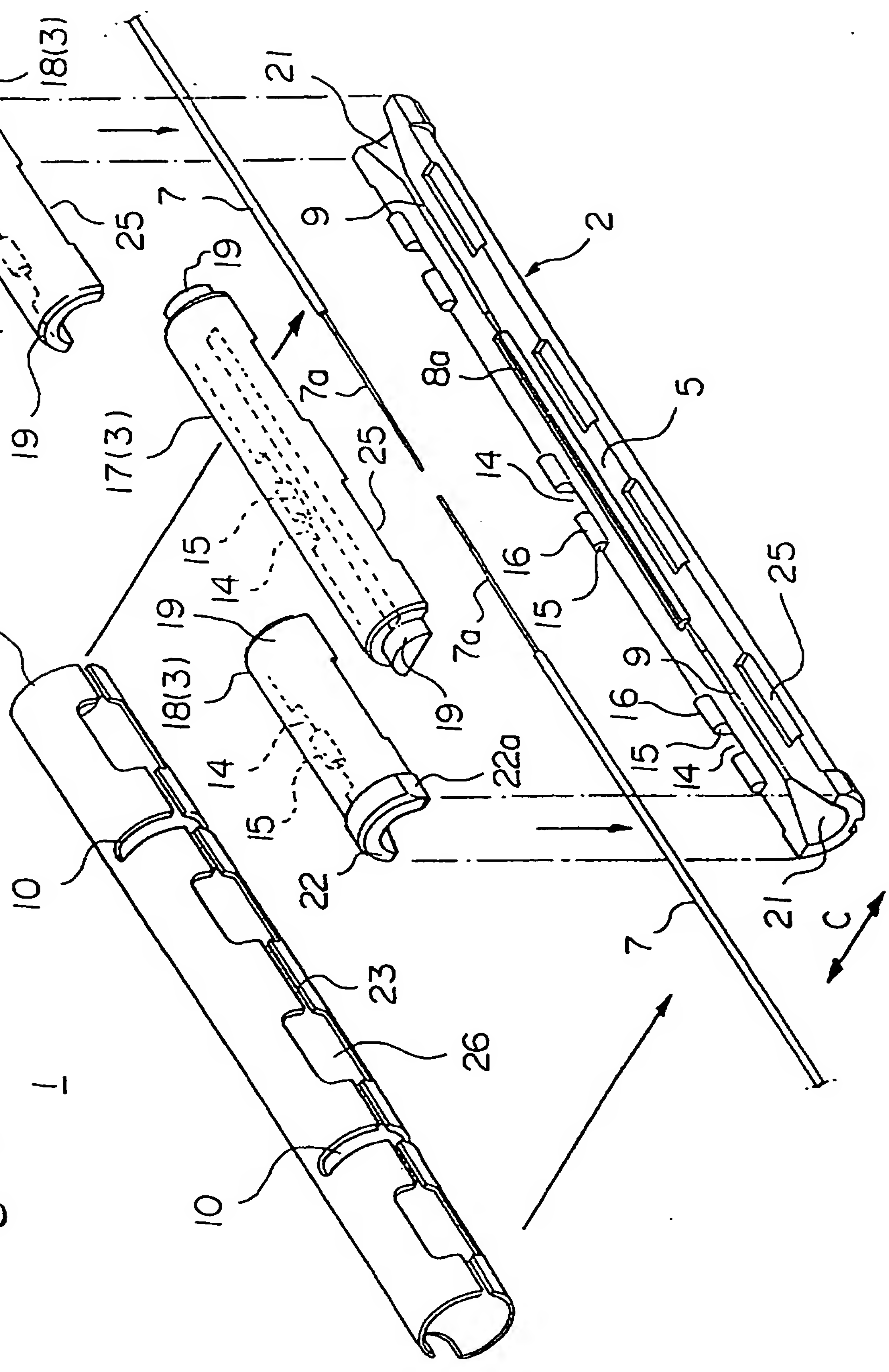
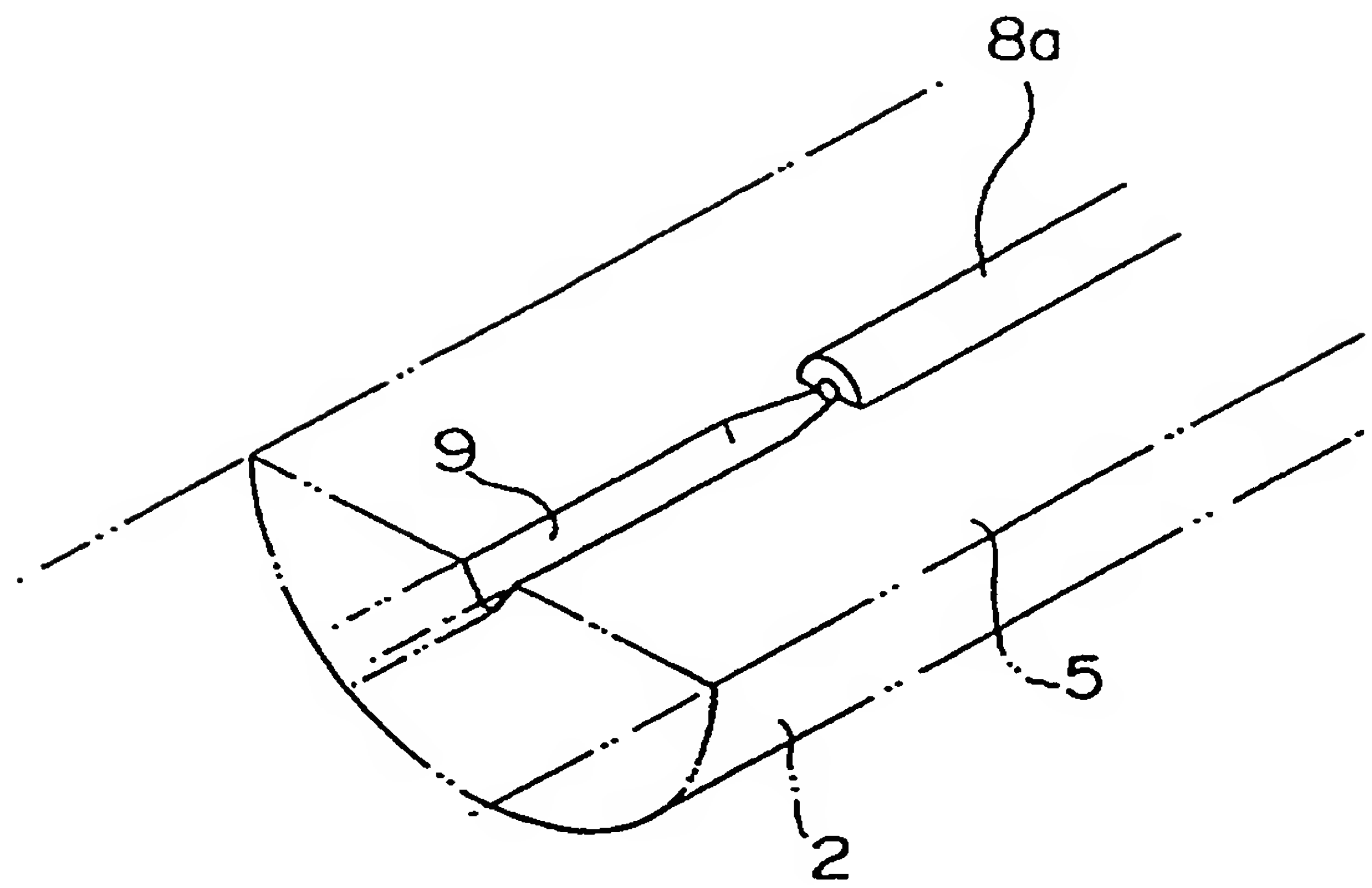
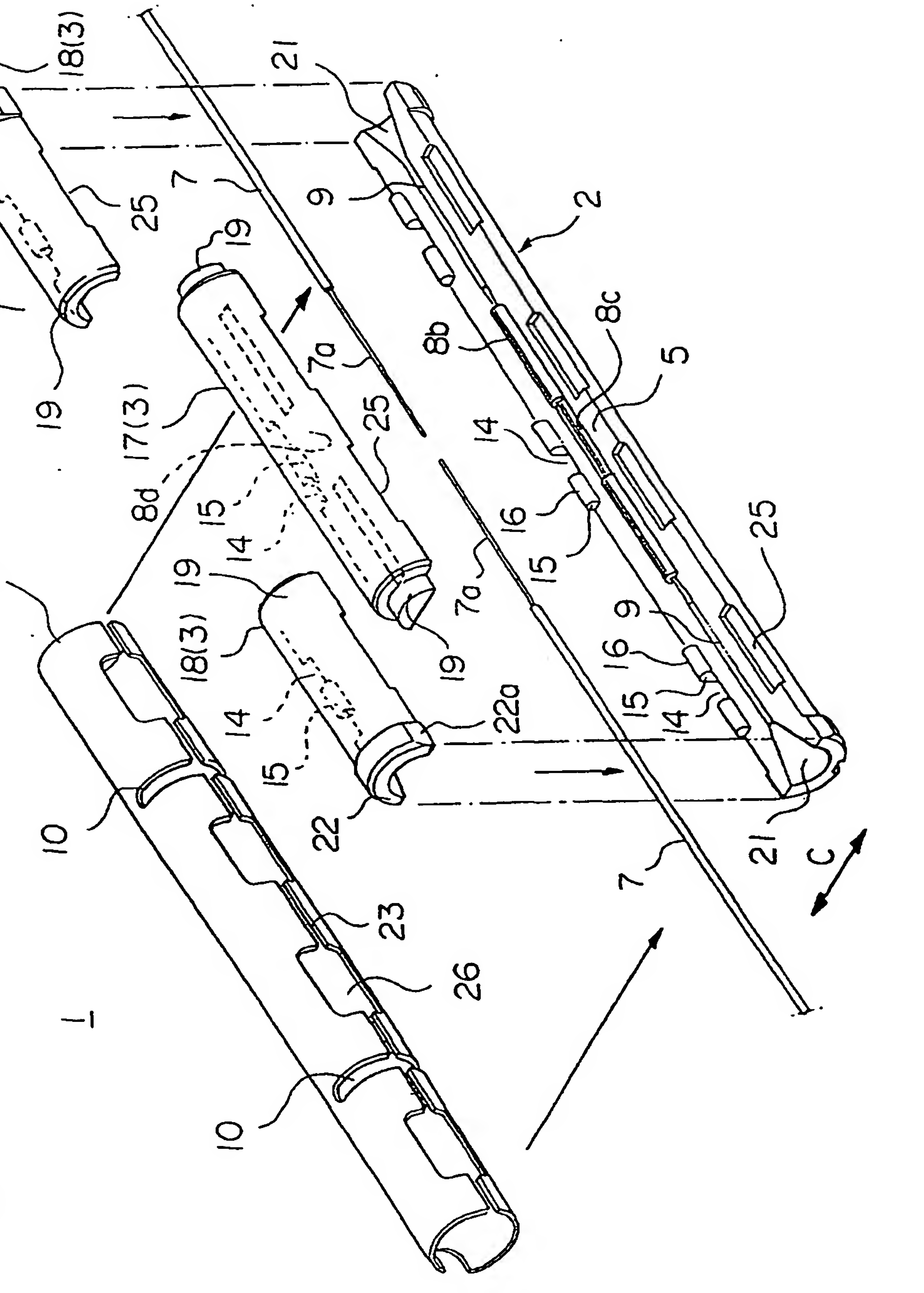


Fig. 14

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19
21
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2
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8b
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17(3)
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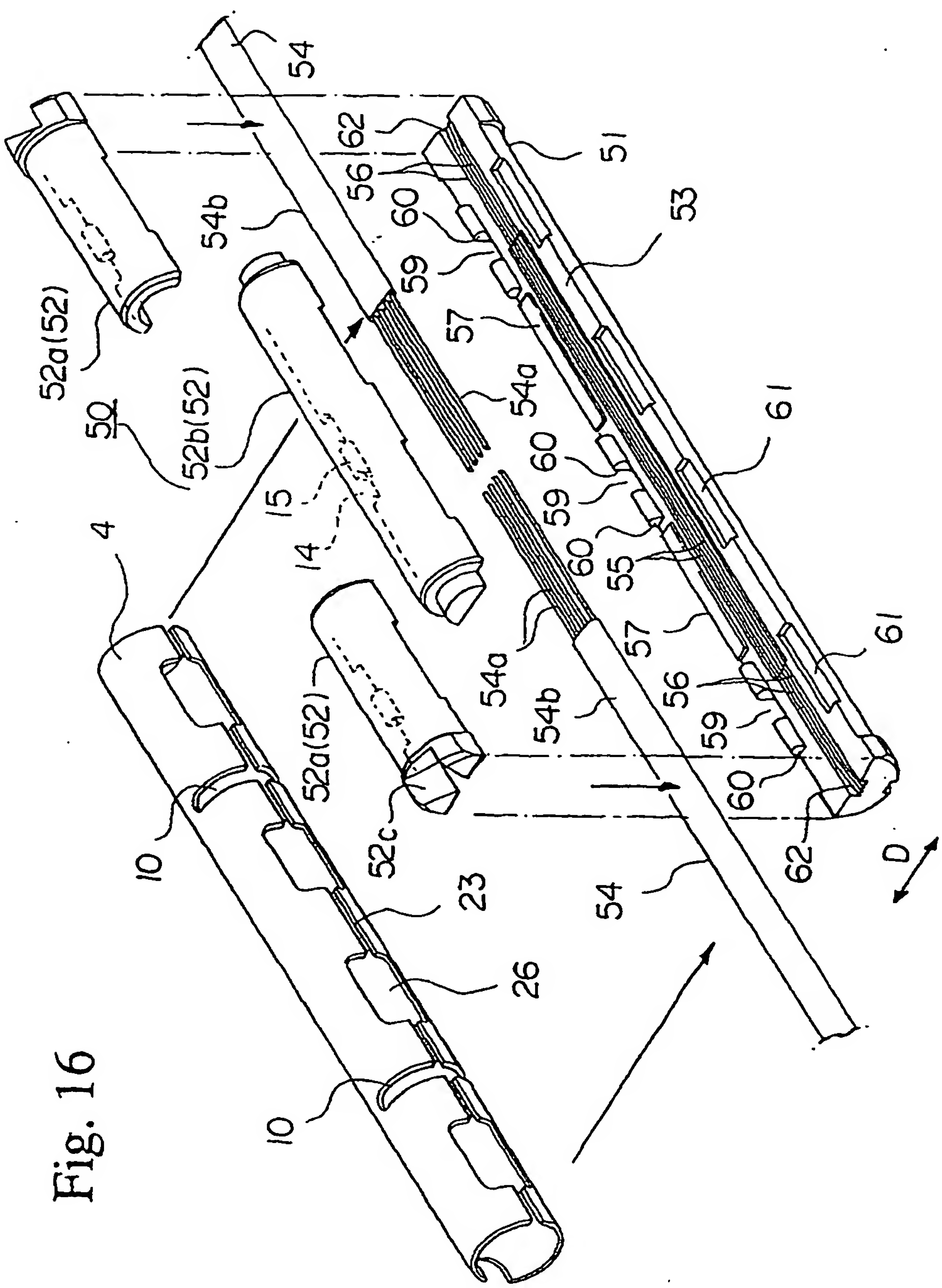
8d
15
14
16
15
19
18(3)
7a
9
16
25
14
15
14
22a
15
4
10
22
21
C
7
23
26
1
10

Fig. 15

Fig. 16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54b
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52b(52)
54a
61
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52a(52)
54a
54b
56
59
60
52c
10
23
26
54
62
D
10

Fig. 17

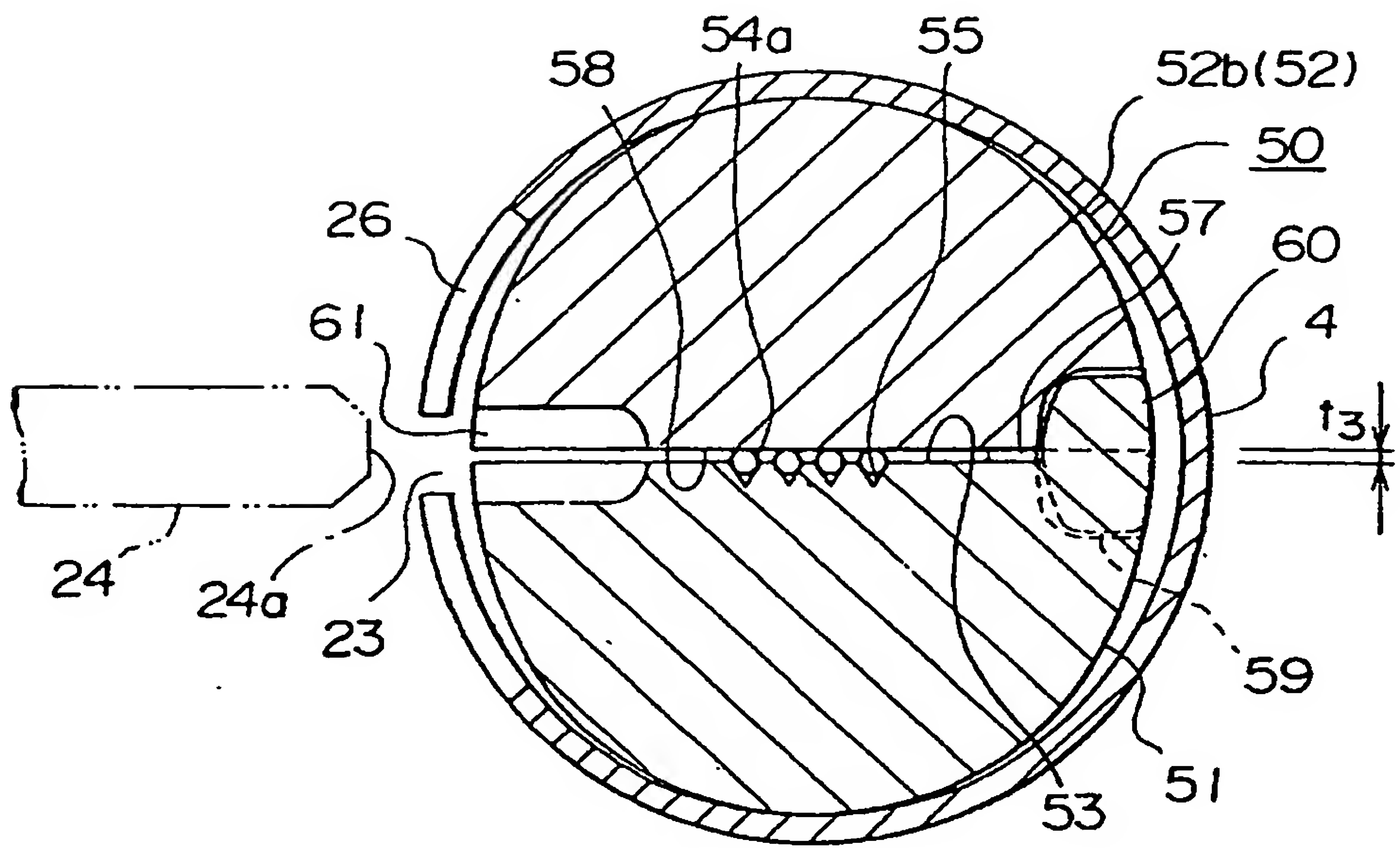


Fig. 18

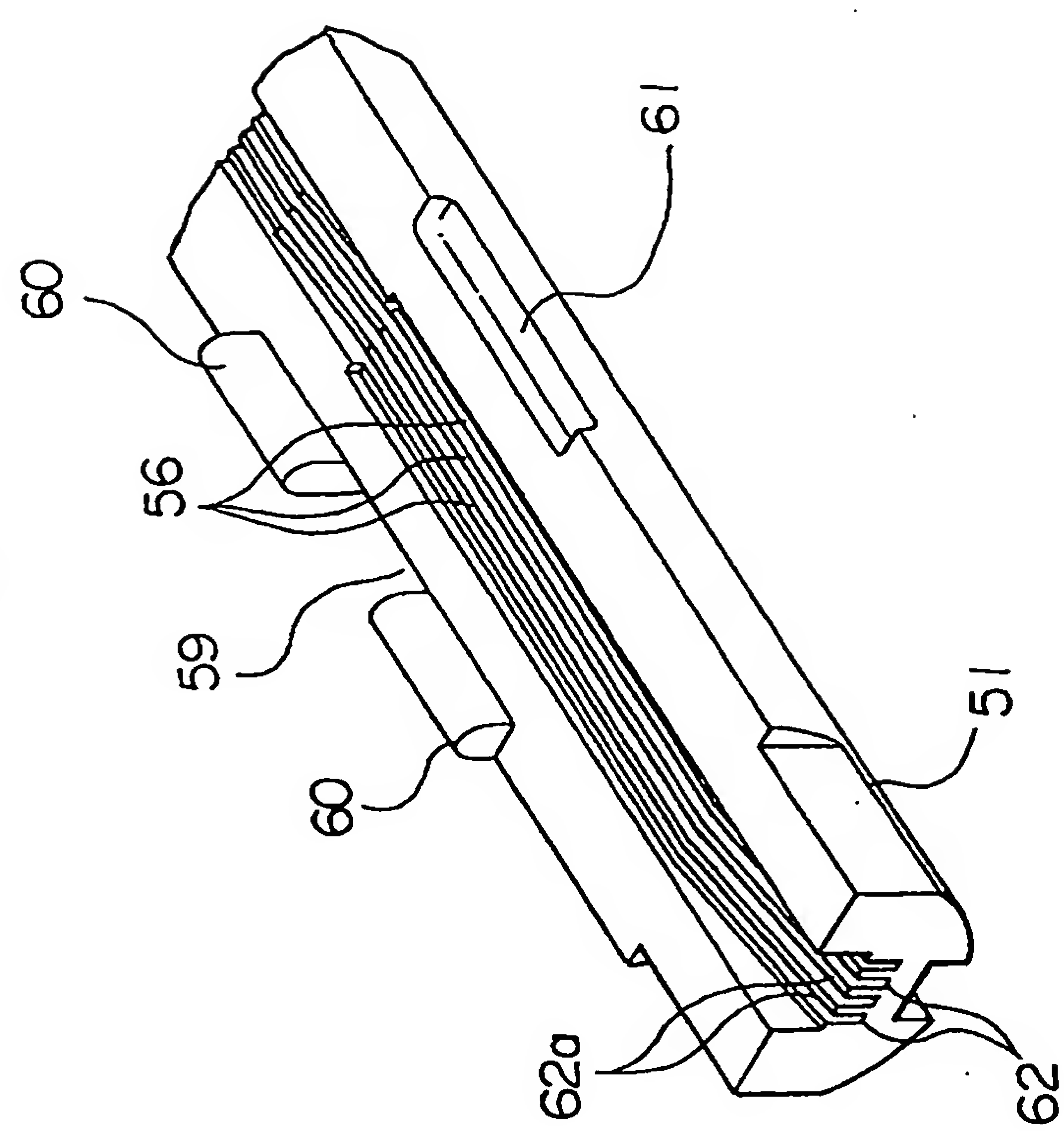
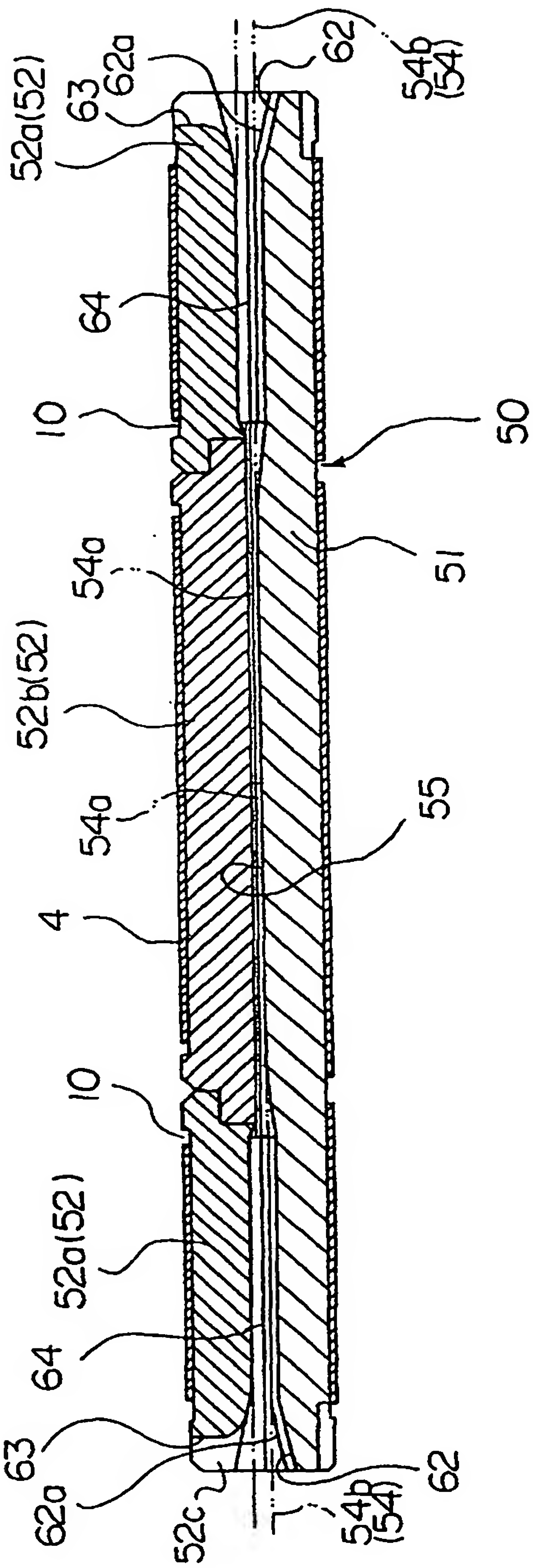


Fig. 19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(54)
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62a
52c
54b
(54)
62

Fig. 20

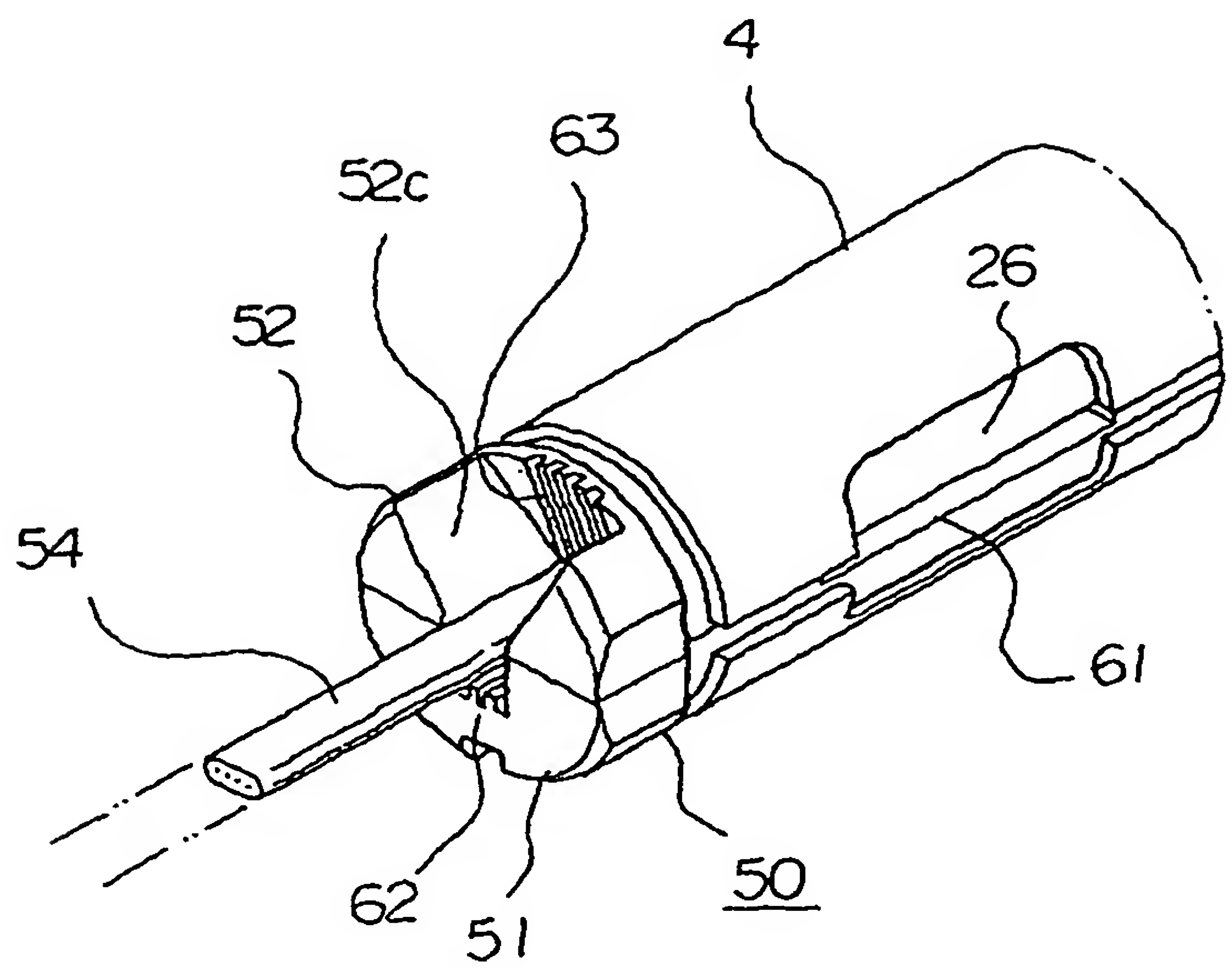
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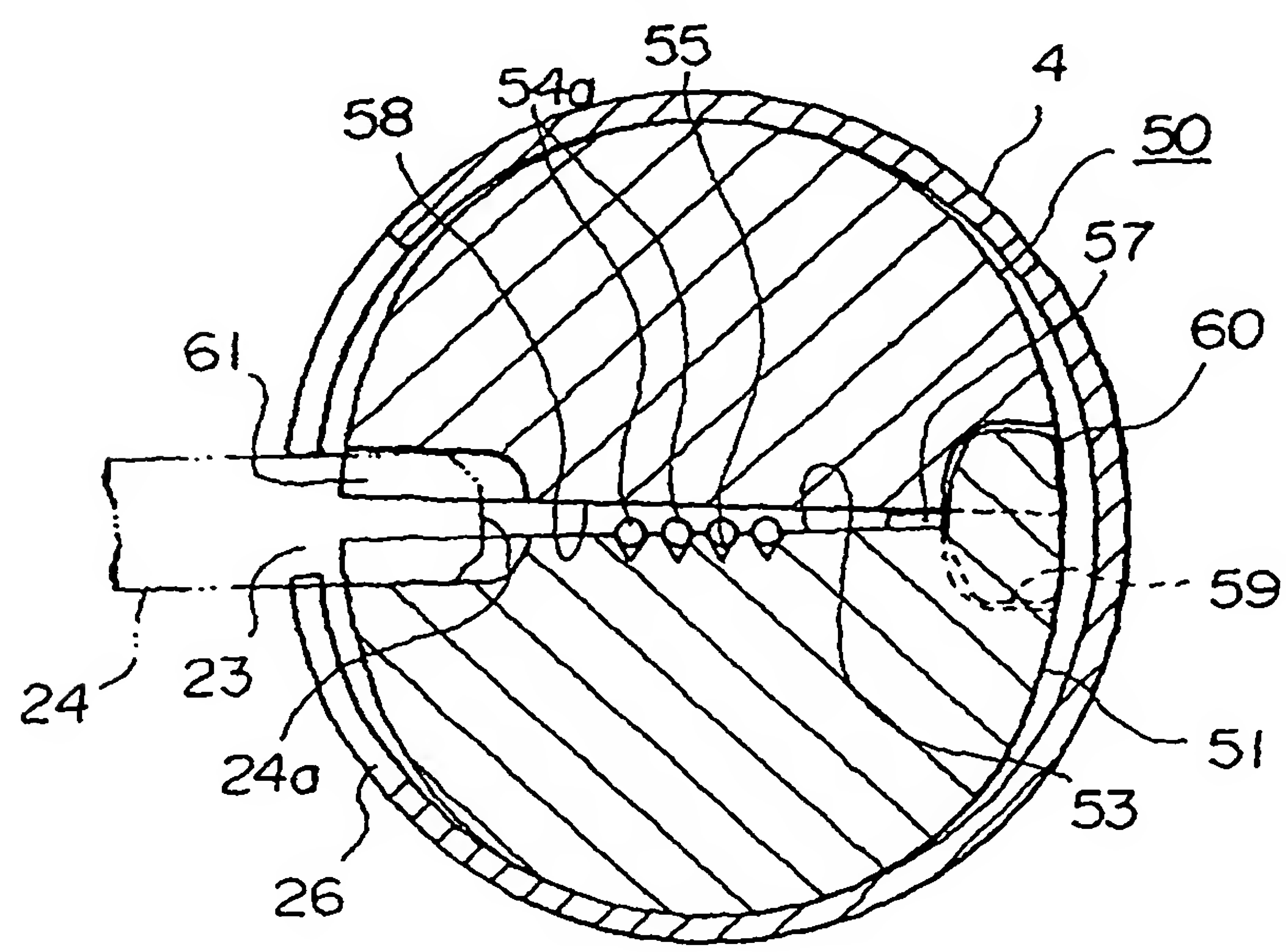
Fig. 21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24a
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